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01-P43398D	TDC ICAP				

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SYSTEM SPECIFICATION AND ARCHITECTURE DOCUMENT (SSAD)

For the

THEATER DEPLOYABLE COMMUNICATIONS INTEGRATED COMMUNICATIONS ACCESS PACKAGE (TDC-ICAP)

Prepared for: Electronic Systems Center,
Air Force Materiel Command, USAF
11 Elgin Street
Hanscom AFB MA 01731-2120

Contract Number: F19628-96-D-0066

Prepared by

MOTOROLA
Systems Solutions Group
8201 E. McDowell Road
P.O. Box 1417
Scottsdale, Arizona 85252-1417

Integrated Systems Division

This document was prepared in accordance with CDRL Sequence Numbers C006 & C007
of the DD Form 1423 to the subject contract.

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1.0 SCOPE

1.1 IDENTIFICATION

This System Specification and Architecture Document (SSAD) describes the system architecture and top level requirements of the Theater Deployable Communications Integrated Communications Access Packages (TDC ICAP). The next higher-level documents which include specifications and design philosophy used to generate the requirements contained herein are the System Requirements Document (SRD) for the Theater Deployable Communications Integrated Communications Access Packages (TDC ICAP), 28 May 1996, the DoD Joint Technical Architecture, Version 1.0, 22 August 1996 and the Technical Requirements Document (TDC) Attachment 3.

1.2 SYSTEM OVERVIEW

The Theater Deployable Communication program provides the war fighter a flexible, lightweight, modular, and scaleable, deployable communication infrastructure. The TDC program includes two major components; the Lightweight Multiband Satellite Terminal (LMST), procured under separate contract, which provides easily deployable long-haul communications; and the Integrated Communications Access Package (ICAP) which provides switched voice, data, video and message traffic user services. TDC ICAP is comprised of standard size, easily transportable functional modules which can be mixed-and-matched to support any deployment**.** Access nodes are distributed to user locations and interconnected via a wireless (Microwave or laser line-of-sight (LOS) links) and/or wired (optical fiber cable) backbone. Deployed locations within the same theater are interconnected via satellite, tropospheric scatter and line-of sight radio systems. Connectivity to locations outside of the theater area is via the Air Force's own commercial and military satellite terminals as well as the host nation's commercial telecommunication facilities.

1.3 OPERATIONAL CONCEPT

The war fighter needs a deployable lightweight communication infrastructure that is modular, scaleable, interfaces with legacy communication systems and can grow as the war fighter's communication requirements increases. The communication capabilities need to efficiently transfer command and control, intelligence, and other mission support data.

The war fighter's primary mission need is modular, expandable communications which supports the efficient transfer of command and control, intelligence and other mission support data as follows:

- Between fixed sites and deployed locations.
- Between deployed locations.
- Between functional areas at each deployed location.
- Between CONUS gateway locations and deployed locations.

TDC ICAP provides these needs of the joint task force commander.

1.4 DOCUMENT OVERVIEW

This document describes the basic system architecture as well as the requirements of the total system and each of its parts. Section 3.1, System Architecture, provides a discussion of the top-level system architecture along with a high level description of the modules used to implement the network. Since each building block module has separable requirements, a stand-alone module requirements document (MRD) is provided for each as appendices. Each MRD includes general module requirements as well as an "as built" listing that describes current module implementation. Section 3.2, Integration and Interface, provides a discussion of TDC ICAP interfaces to companion DoD systems and networks. In addition, Section 3.2 includes a summary of inter-module interface requirements necessary to ensure that modules will interoperate with each other and a high level description of TDC ICAP system level external electrical inputs and outputs. Section 3.3, Functional Requirements, provides the system level requirements for the TDC ICAP entity. These requirements may be thought of as the "transfer function" between ICAP inputs and outputs. Section 3.4, Logistics Requirements provides the supportability concept and requirements. Section 3.5, Environmental Requirements and Section 3.6, Other Requirements provide additional provisions common to all modules.

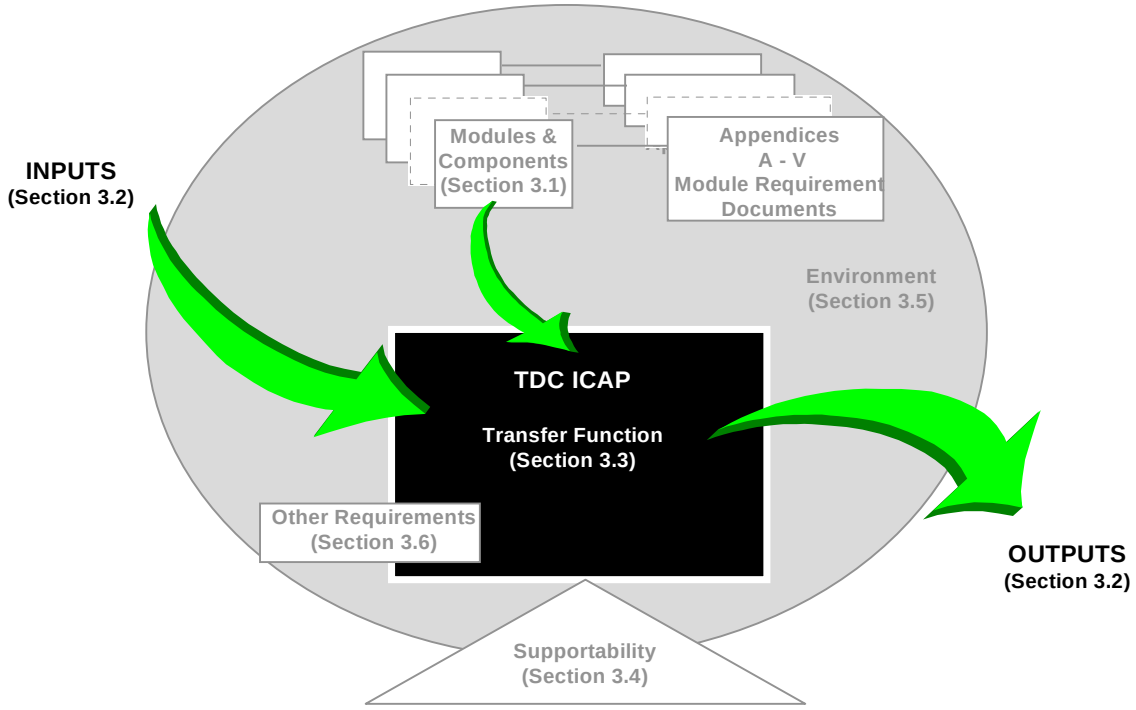


Figure 1: SSAD Section 3 Organization

2.0 APPLICABLE DOCUMENTS

To the extent specified herein, the following documents of latest current issue on the date of this document, form a part of this specification.

Document Number	Title
	DoD Joint Technical Architecture, Version 1.0, 22 August 1996
DOD 5200.28-STD	Guideline for Determining Minimum AIS Requirement
CJCSM 6231.04	Manual for Employing Joint Tactical Communication Systems, Joint Transmission Systems
EIA Standard RS-470	Telephone Instruments with Loop Signaling for Voiced Applications
EIA-530	High Speed 25 Position Interface for Data Terminal Equipment and Data Circuit Terminating Equipment
F19628-95-R-0069, Attachment 8	System Requirements Document (SRD) for the Theater Deployable Communications Integrated Communications Access Packages (TDC ICAP), 19 April 1996
IEEE Standard 802.3	Telecommunications and Information Exchange Between Systems -- Local and Metropolitan Area Networks -- Specific Requirements
IEEE Supplement 802.3J SUPP	Supplement to Local and Metropolitan Area Networks: Fiber Optic Active and Passive Star-Based Segments, Type 10BASE-F.
ITU Recommendation G.703	Physical/Electrical Characteristics of Hierarchical Digital Interface Circuits
ITU Recommendation G.704	Synchronous Frame Structures Used at 1544, 6312, 2048, 8488, and 44 736 kbit/sec
ITU Recommendation G.705	Characteristics Required to Terminate Digital Links or a Digital Exchange
ITU Recommendation V.35	Wideband Modems
MIL-STD-810E	Environmental Test Methods
MTR-84W00037 (Mitre)	TRI-TAC Equipment Interface Plan
NFPA-70	National Electric Code
TIA/EIA 422	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
Title 29, Code Of Federal Regulations, Chapter XVII, Part 1910	Occupational Safety Health Standards
68-P39024D001 (Motorola)	STU III/R Operation, Installation and Maintenance Manual

3.0 REQUIREMENTS

3.1 NETWORK ARCHITECTURE

The ICAP is a scaleable network that provides telephone, video, data (red and black) and switched message service to multiple users deployed at various locations within an approximate 5 km. square metropolitan area. The ICAP metropolitan area network (MAN) is a hub and spoke design that supports redundant connections to critical user nodes. The architecture permits user nodes to be connected to either a primary network hub (base hub) or to another user node. In addition, the ICAP network may be connected as nodes of external wide area networks. A notional concept of the ICAP MAN is presented in Figure 2.

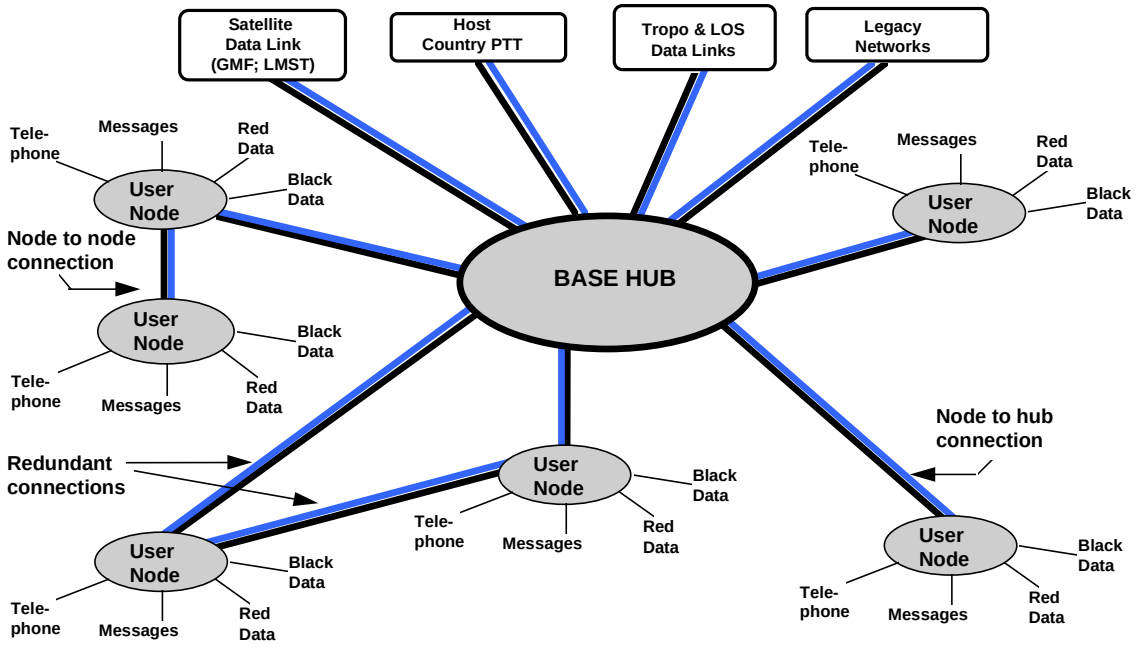


Figure 2: Notional ICAP Metropolitan Network Architecture

3.1.1 Network Types

TDC ICAP is implemented with two independent network types. The Switched Circuit Network (SCN) provides service for telephones, video teleconferencing, AUTODIN/DMS message terminals and point-to-point serial digital data connections. The Datagram Switching Network provides Internet Protocol (IP) data services for Ethernet and serial IP data users (Figure 3). These networks extend through external connections to similar type DoD legacy networks.

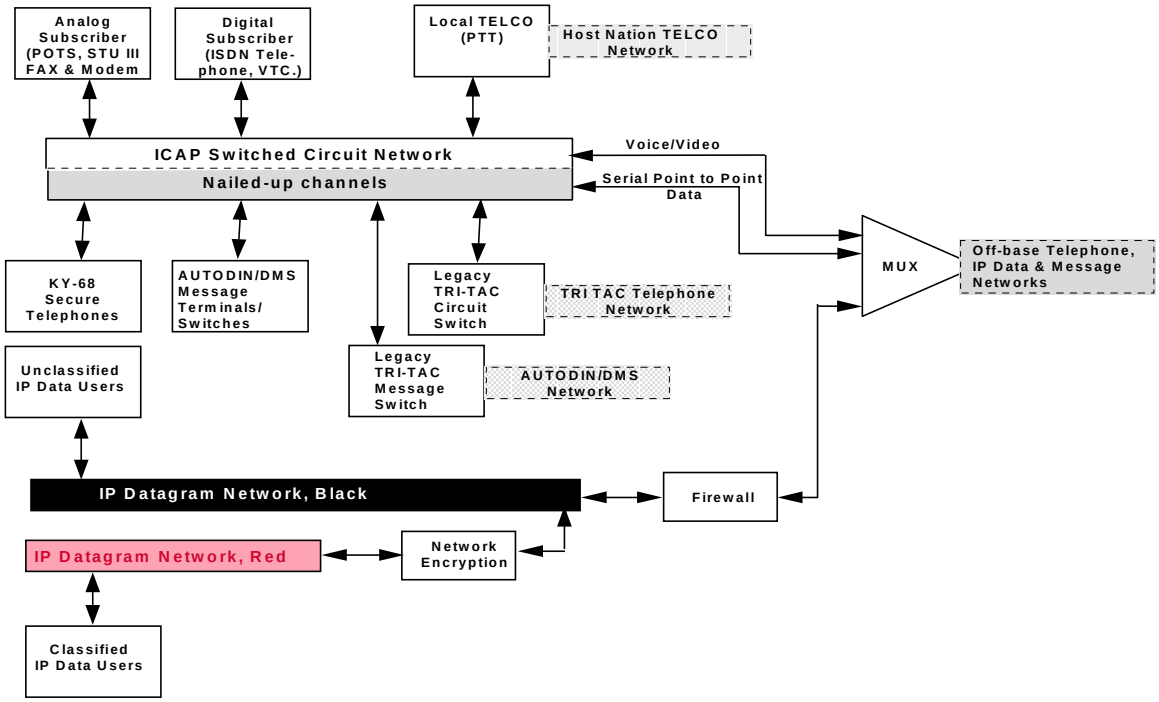


Figure 3: ICAP Network Types and Data Flow

3.1.1.1 Switched Circuit Network

The ICAP provides a scaleable, switched circuit network (SCN) with intra-base connectivity between network subscribers and off-base connectivity with DoD and commercial telephone networks. The ICAP switched circuit network accommodates both analog (WECO 2500 telephones, FAX, STU III telephones and PC Modems) and digital (ISDN telephones, video teleconferencing) subscribers.

3.1.1.1.1 Circuit Switches

The SCN is implemented by a set of circuit switches at the nodes and hubs interconnected by backbone digital trunk lines. Each switch is scaleable in the field to provide service for a variable number of subscribers and is field programmable to match any seven or ten digit numbering plan. The complete network of switches implement AUTOVON compatible multi-level priority and preemption as well as standard commercial features such as conferencing, hot lines, call forwarding, call restriction, etc.

3.1.1.1.2 ISDN Compatibility

The SCN circuit switches are ISDN capable and include ISDN interfacing capability. This permits an operator to establish point-to-point digital data channels for specialized applications using ISDN terminal adapters (the ISDN equivalent of a modem).

a. *KY-68 Telephones.* In conjunction with custom card feature and the KY-68 Interface Card provides access to 2 each KY-68s per card. The special cards implement long local loops between KY-68 secure telephones located at user nodes and a legacy TRI-TAC circuit switch such as the AN/TTC-39 located at the network's hub.

b. *AUTODIN Message Terminals.* ICAP uses ISDN TAs and “nailed-up” ISDN B-channels to implement long local loops between CGS-100 or similar message terminals and an external AUTODIN/DMS message switch.

3.1.1.2 Datagram Switching Networks.
The ICAP provides scaleable IP data networks for both red and black users (Figure 4).

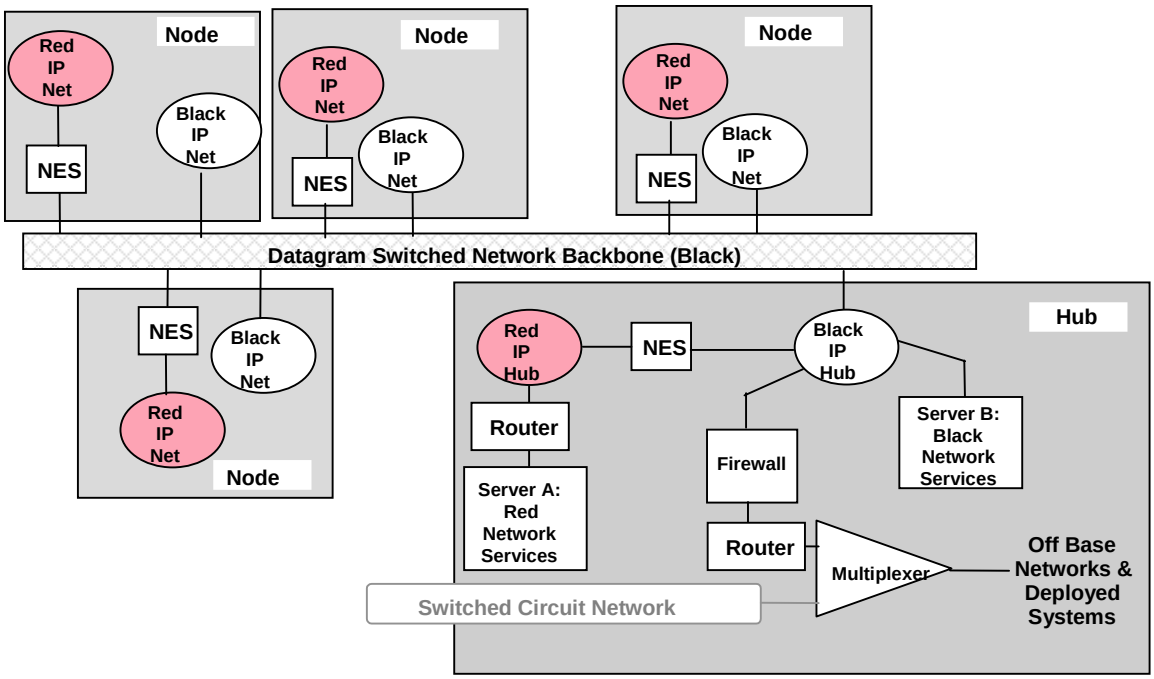


Figure 4: TDC ICAP Datagram Switching Networks

3.1.1.3 Local Area Networks
Each node provides *segmented* local area network extensions of the SCN and Datagram Switched Networks. That is, datagrams and SCN traffic sent and received on the same node never leave the node (Figure 5).

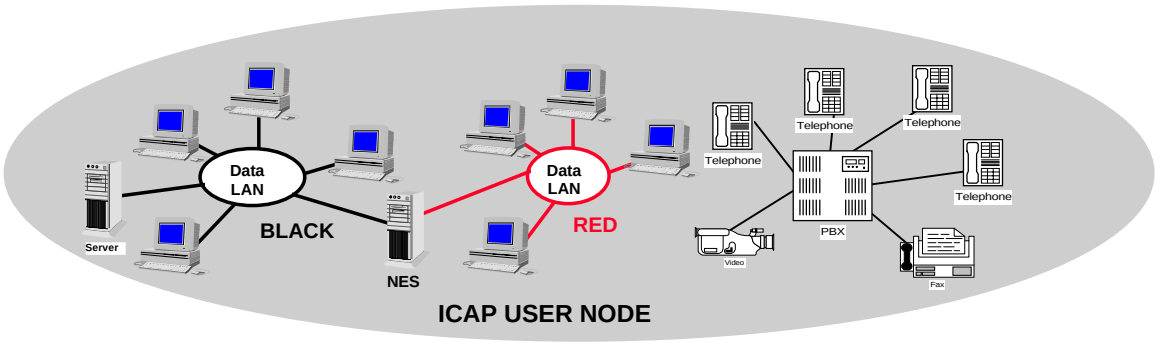


Figure 5: TDC ICAP User Node

3.1.1.4 Backbone Connections.
Each node has at least two external backbone connections for both the SCN and Datagram Switched Network for node-to-node and/or node-to-hub interconnects (inter-node connections) (Figure 6). The datagram backbone connection provides 10/100 Mbps Ethernet connectivity. SCN backbone connections provide 1.536 Mbps ISDN PRI connectivity.

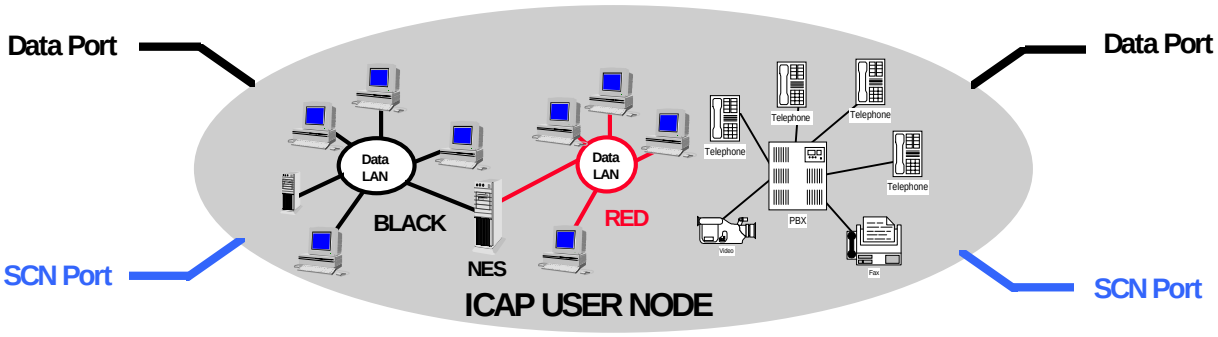


Figure 6: User Node Backbone Connectivity

3.1.1.5 Metropolitan Area Network
The interconnection of nodes and hubs via the SCN and Datagram Switching Network backbone forms a single TDC ICAP base network (Figure 7).

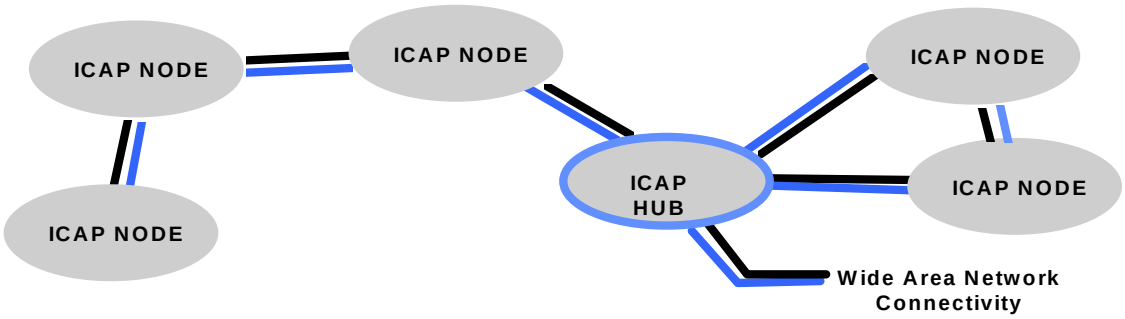


Figure 7: Interconnection of nodes and hubs defines the TDC ICAP Metropolitan Area Network.

3.1.1.6 Wide Area Network.
The TDC ICAP metropolitan area network may be connected externally to other networks. Once these connections are made, ICAP becomes a node of these other networks (Figure 8). TDC ICAP provides wide area connectivity

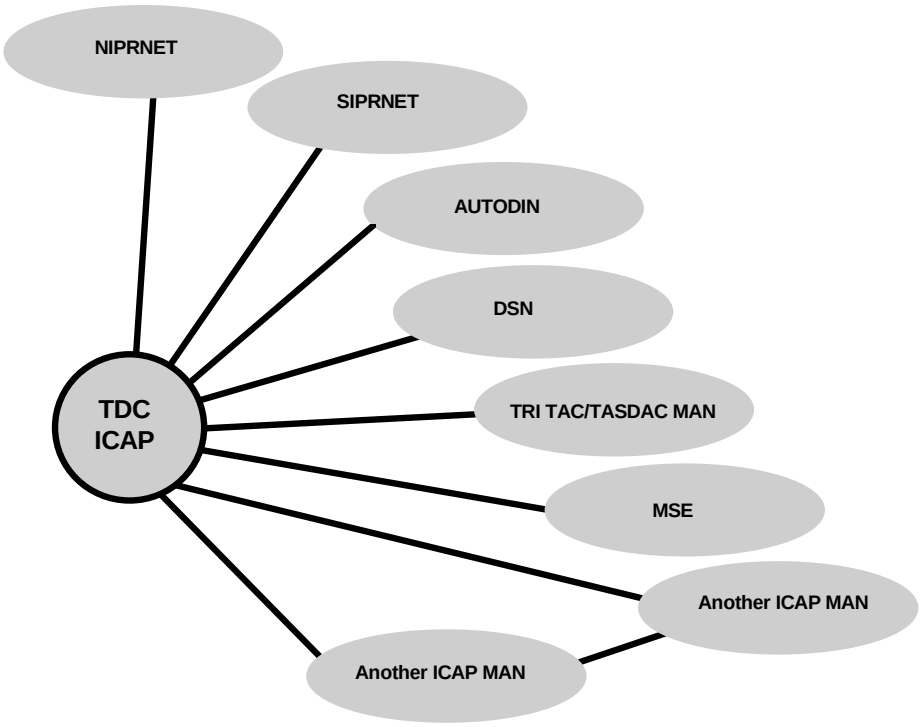


Figure 8: TDC ICAP as a node in a larger network

via direct connections to the SCN and Datagram Switching Networks. In addition, ICAP provides both Promina (P-MUX or IDNX) and AN/FCC-100 multiplexed switched circuit/datagram network connections for external interface via band limited communication channels.

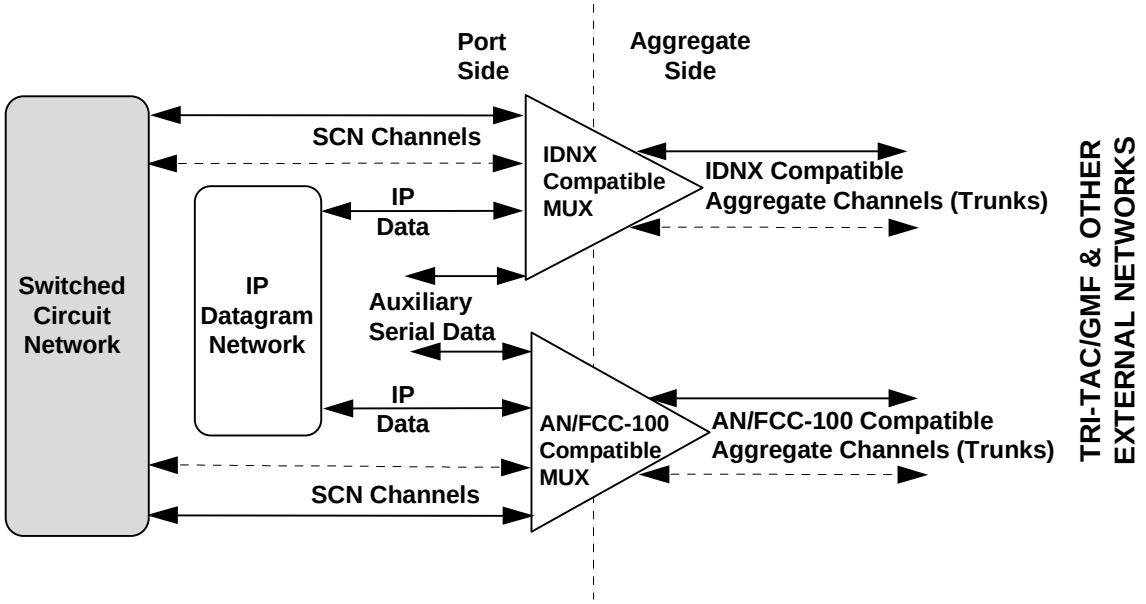


Figure 9: TDC provides multiplexed network connections for wide area connectivity.

3.1.2 Modularity and Scalability

TDC ICAP is designed to support the communication requirements of various sized deployments from just a handful of users to a full wing or Joint Air Force Command Component. The ICAP is made up of a set of building blocks housed in man-transportable transit cases (Figure 10). Complete building blocks that occupy a full transit case and are designed to operate within the case are called "modules". Individual ICAP building block "components" such as, modems, ISDN terminal adapters, telephones and unique module LRUs which are transported collectively in carrying cases but designed to be taken out and distributed as needed are referred to by their common name. In addition, the ICAP includes cable sets (cable with connectors attached) to enable an installer to interconnect modules and individual components.

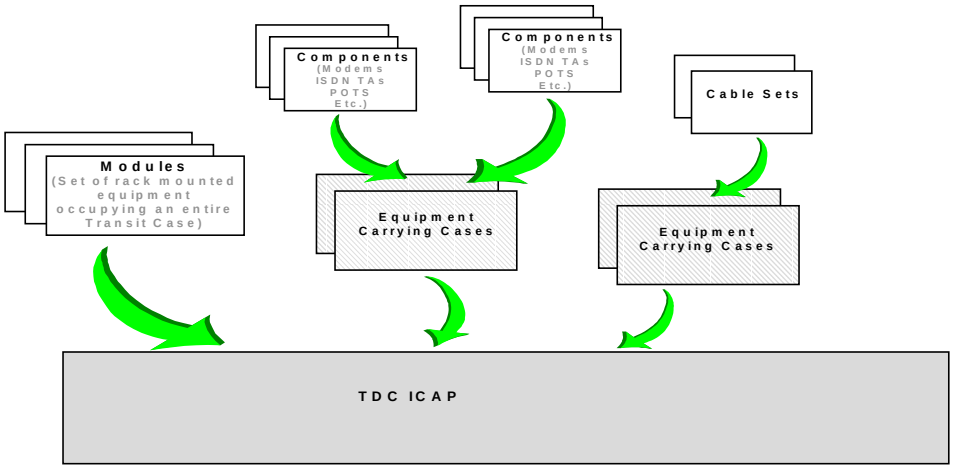


Figure 10: TDC ICAP Composition

The basic complement of modules and components may be categorized according to whether their primary function is "backbone implementation", "subscriber service" or "network service". In addition, modules and components may be further classified in accordance with their application (Figure 11). Although most support a single application; e.g., the Red Router Module is used only to implement the Red Datagram Switched Network; some contain functional elements that cross the boundaries. For example, the Basic Access Module interfaces to both the Datagram Switched Network and the Switched Circuit Network.

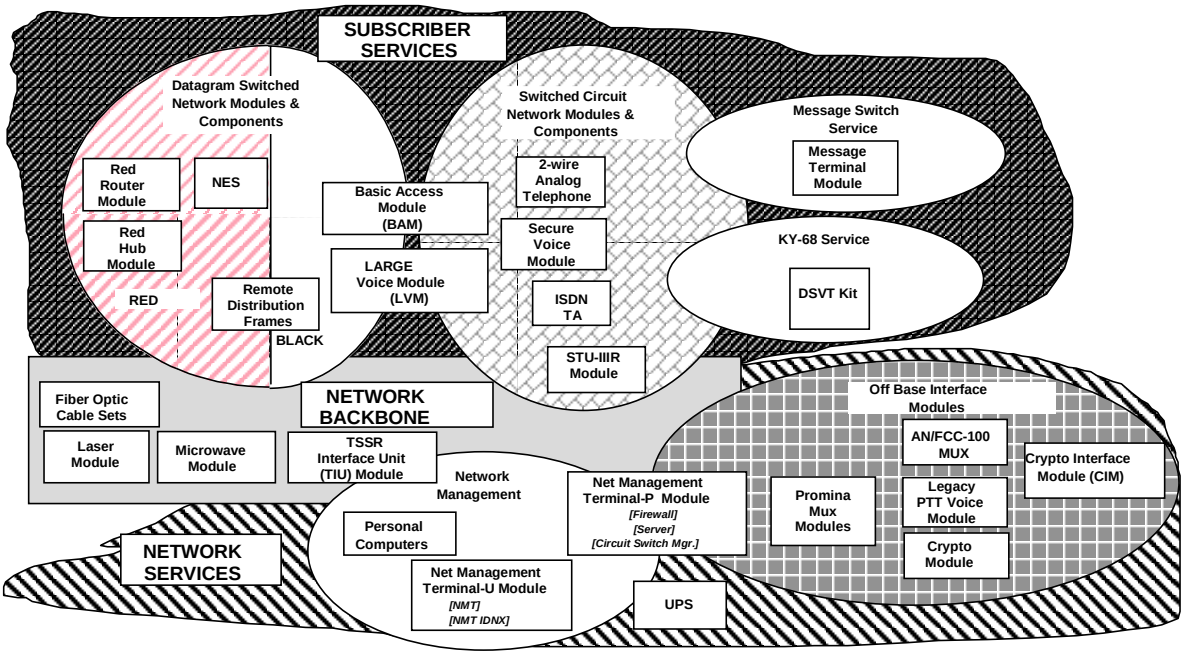


Figure 11: TDC ICAP Modules and Components Categorized by Application

3.1.2.1 Network Backbone.
The modules and components that make up the backbone are used by the installer to interconnect the various node and hubs of the network.

3.1.2.1.1 Cable Sets
TDC ICAP include the cable sets listed in Table 1 which are used for internode and hub to legacy terminal and switch interconnection. Fiber optic cable connectors permit series connections using “barrels” or repeaters to achieve greater cable lengths.

Table 1: Standard TDC ICAP Backbone Cable Sets

Designator	Application	Length (Feet)	Characteristics
W1a	Inter-node connection	1000	3 Pair fiber optic (multi-mode) cable with individual connectors on each fiber end. Implements the wired interconnection requirements in paragraph 3.3.3.1.1.
W1b	Inter-node connection	250	3 Pair fiber optic (multi-mode) cable with individual connectors on each fiber end. Implements the wired interconnection requirements in paragraph 3.3.3.1.1.
W1c	Inter-node connection	50	3 Pair fiber optic (multi-mode) cable with individual connectors on each fiber end. Implements the wired interconnection requirements in paragraph 3.3.3.1.1.
W2a	Conditioned diphase connection to legacy terminal or switch.	100	TRI-TAC CX-11230 Cable Assembly
W2b	Conditioned diphase connection to legacy terminal or switch.	1320 (¼ mile reel)	TRI-TAC CX-11230 Cable Assembly
W3	3 twisted pair cable.	1000 (spool)	Cut to length in field; Three pair cable; RJ-11 connectors and installation tool supplied.
W4	ISDN Terminal Adapter Connection	10	RJ-11 male to RJ-45 male; RJ-45 pins 4&5 to RJ-11 pins 3&4.
W5	4 twisted pair cable	1000 (spool)	Cut to length in field; four pair cable; RJ-45 connectors and installation tool supplied.
W6a	RS-232	10	DE-9 to DE-9 (DTE to DCE)
W6b	RS-232	10	DB-25 to DE-9 (DTE to DCE)
W7a	RS-530	10	IAW EIA-530 (DTE to DCE)
W7b	RS-530	25	IAW EIA-530 (DTE to DCE)
W7c	RS-530	100	IAW EIA-530 (DTE to DCE)

3.1.2.1.2 Microwave Module

The Microwave Module implements the RF line-of-sight (LOS) link function described in paragraph 3.3.3.1.2. The physical interconnection design of the Microwave Module is such that a pair of modules may be inserted "in series with" a three pair fiber optic interconnection cable (Figure 12). The Microwave Module provides 2 DS1 connectivity each for both datagram and switched circuit networks. Although the module's radio transmitter and receiver are tunable in the field, they contain filters that are pre-tuned at the factory to cover one-of-four sub-bands within the radio's 14.4 GHz to 15.35 GHz communication band. Transmit and receive frequencies of the same radio (single module) are normally selected in different sub-bands to maximize T/R frequency separation. Since the transmit frequency of one module must correspond to the receive frequency of the second module and each frequency is within a different sub-band, Microwave Modules are selected in pairs.

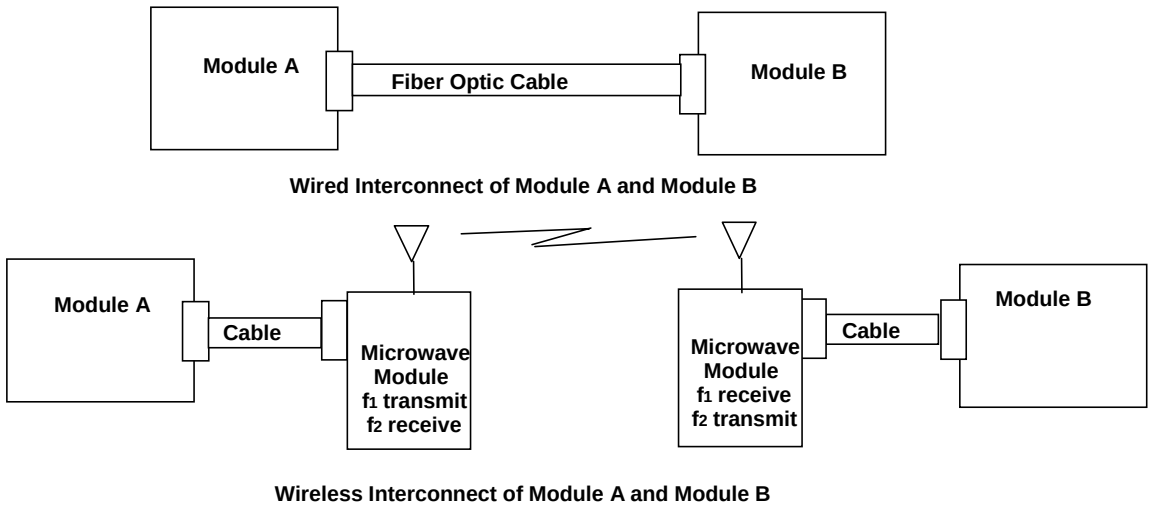


Figure 12: Interconnection of Module Using a Fiber Optic or Wireless LOS

3.1.2.1.3 Laser Module

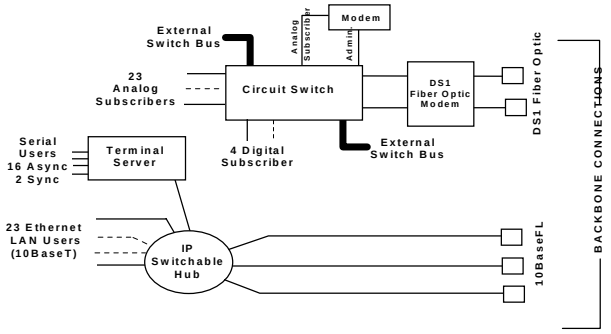
The Laser Module implements the laser LOS link function described in paragraph 3.3.3.1.2. The Laser Module maintains the 10BaseFL and 1 DS1 connectivity of the fiber optic cable set (paragraph 3.1.2.1.1) for datagram and switched circuit networks. The physical interconnection design is identical to that of the Microwave Module diagrammed in Figure 12.

3.1.2.1.4 TSSR Interface Unit Module

The TSSR Interface Unit (TIU) Module permits an installer to implement the LOS wireless backbone connection with an AN/GRC-239 tropo-satellite support radio (TSSR). The TIU Module/TSSR combination provides 2 DS1 connectivity for both datagram and switched circuit networks. The physical backbone interconnection to the TIU is identical as that to the Microwave Module diagrammed in Figure 12.

3.1.2.2 Subscriber Services.
These modules and components are used to implement the voice and data local area and metropolitan area networks described herein. That is, when connected together by the MAN backbone, they provide the subscribers with all network features except those that require off-base connectivity.

3.1.2.2.1 Basic Access Module/Basic Access Module v2
The Basic Access Module has been upgraded and the upgraded module is designated as Basic Access Module v2, both versions will be referred to as a BAM, the text will point out the differencest where required. The BAM (Figure 13) provides SCN and Datagram Switched Network connections for small to medium groups of users. The Basic Access Module includes both an internal circuit switch that implements a private branch exchange (PBX), a switchable hub to permit users to create local area IP datagram networks and a terminal server for serial subscriber access to the IP networks. In the Basic Access Module v2 the hub and terminal server has been replaced with two 10BaseT/100BaseTX Ethernet switches. The BAM provides two SCN and three (v2 four) datagram network backbone connections which may be interconnected to the network hub or to another network node. The basic circuit switch configuration; i.e., no optional circuit cards; provides service for up to 23 analog subscribers†, 4 digital subscribers and provides two ISDN PRI or T1 trunks. However, the installer may customize the switch by adding additional line replaceable units (circuit cards) for increased subscriber access (up to 95) and switch functionality. An integral modem permits circuit switch administration from a remote location.



Original BAM

† All of the circuit switches contained in ICAP modules have one additional analog subscriber port that is wired to a modem used for remote circuit switch administration.

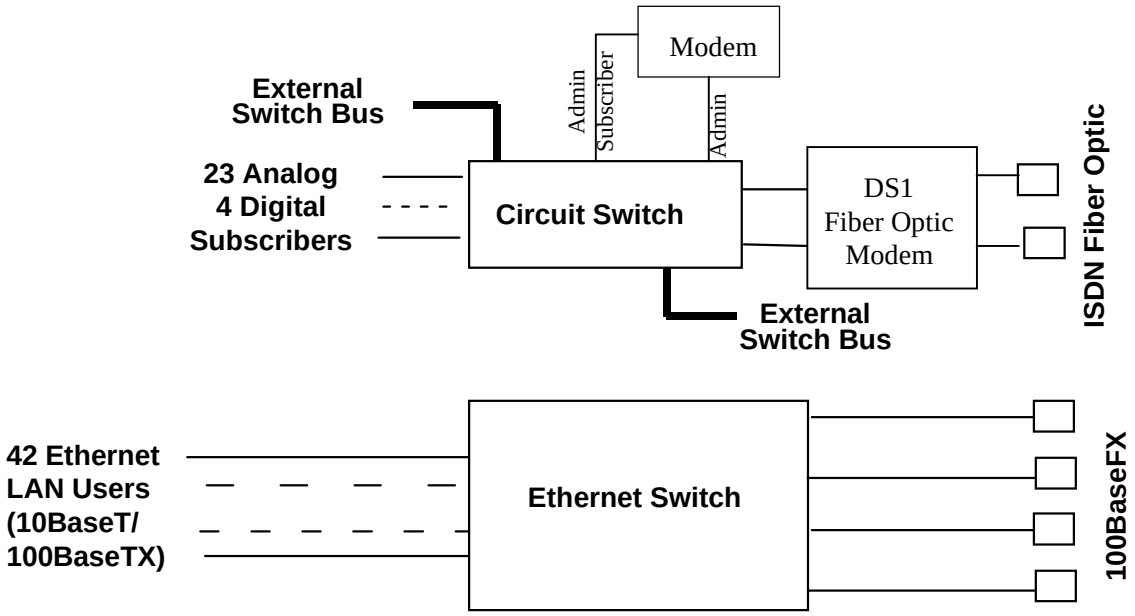


Figure 13: BAM, Functional Block Diagram
BAM V2

The BAM provides two external circuit switch backplane bus connections so that circuit switches may be stacked via the switches' internal backplanes (Figure 14). † This connection permits additional SCN subscribers to be added to a single switch function by using a second BAM. In addition, this connection allows a set of BAMs to interface to a large number of trunks from other nodes as will typically be required at the network's primary SCN hub. Similarly, the three 10BaseFL in the Basic Access Module and the four ~~10BaseFl/~~100BaseFX in the BAM v2 backbone connections to the Ethernet switches permit the LANs formed by multiple modules to be connected together. Again, in addition to providing more connections for data users, this architecture permits multiple BAMs to form the network's primary data hub (Figure 15).

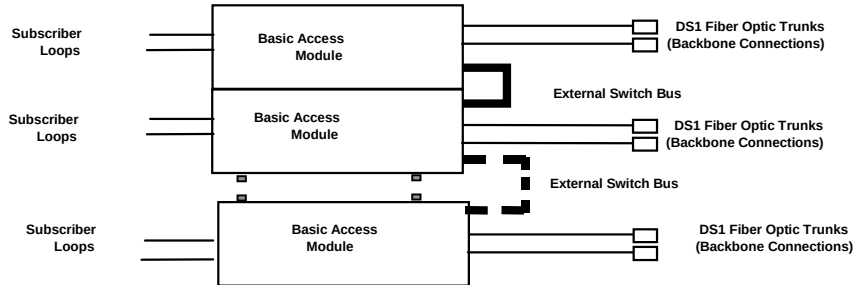
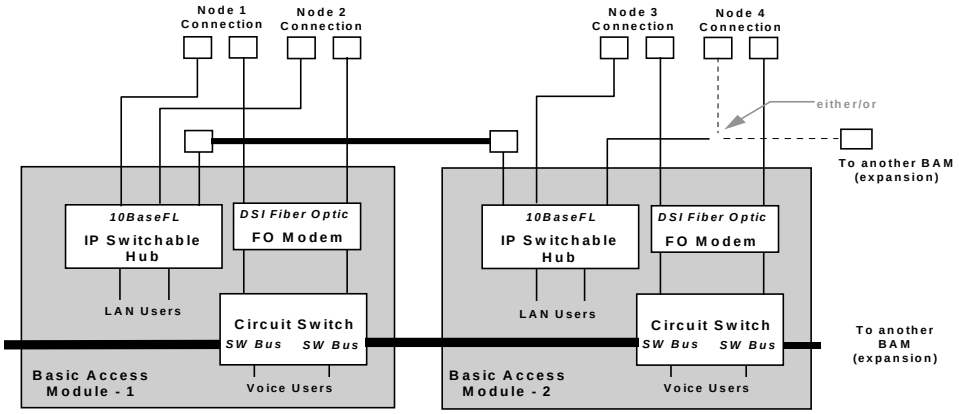
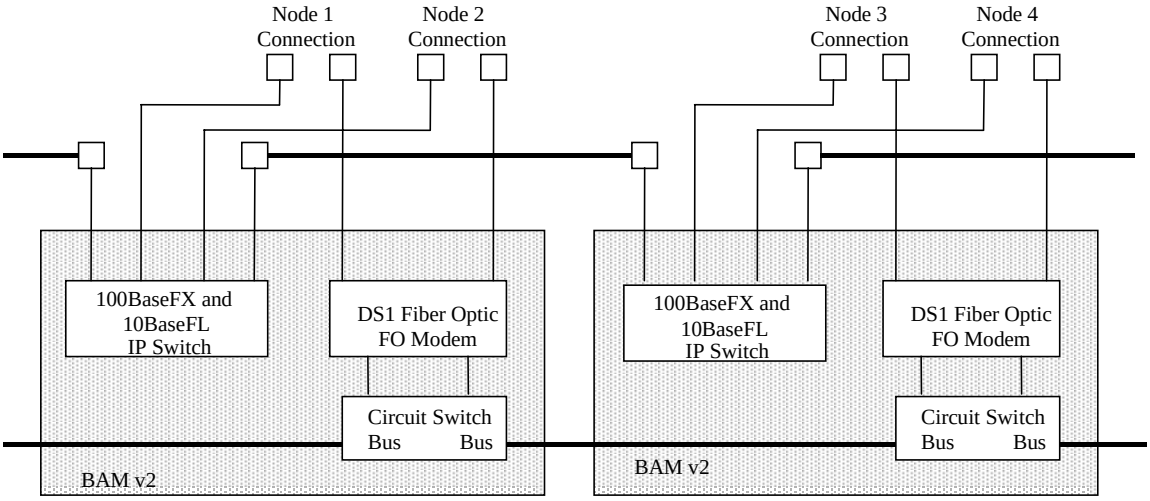


Figure 14: Stacked interconnection of BAM circuit switch provides service for additional voice/video subscribers.



Original BAM



BAM V2

Figure 15: Stacked interconnection of Basic Access Modules to provide network hub connections for multiple user nodes.

3.1.2.2.2 Configura[*ble*]*~~tion~~ Access Module (Obsolete)*

3.1.2.2.3 Red Hub Module

The Red Hub Module (Figure 17) provides Datagram Switched Network service for classified users. The module includes a seven slot chassis that is specifically designed to accept compatible hub, router and similar network communication line replaceable units (LRUs). The chassis contains four (4) backplanes that provide four independent high-speed data communication channels between LRUs.

The LRU complement included in the basic configuration provides a segmented IP hub that allows the installer to configure up to four independent LANs (each independent LAN consumes one of the four backplane channels), a terminal server and router LRU. In addition, the Red Hub Module includes an NSA approved Motorola Ethernet network encryption system (NES) between the hub and its 10BaseFL backbone connection. An

administration port on the NES permits an operator to enter time of day using a laptop personal computer. The Red Hub includes two 10BaseFL user connections. This allows the installer to connect two classified "remote" users with fiber optic cable and avoid the TEMPEST problems associated with copper conductors.

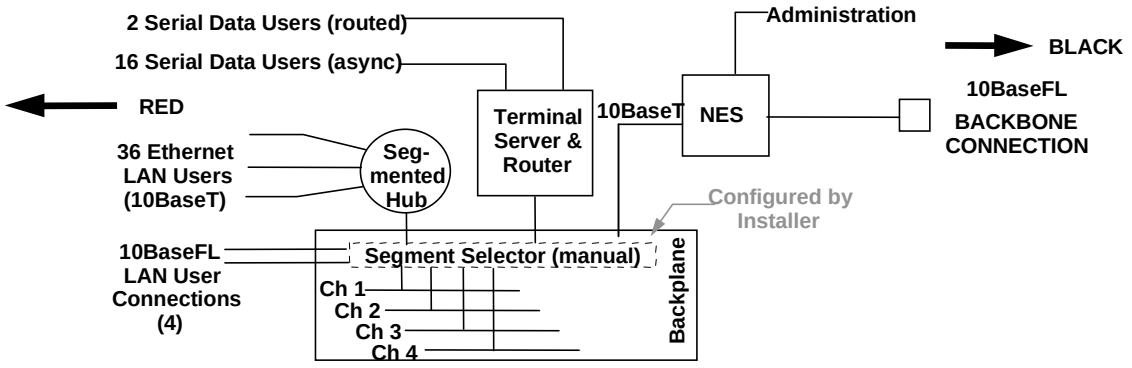
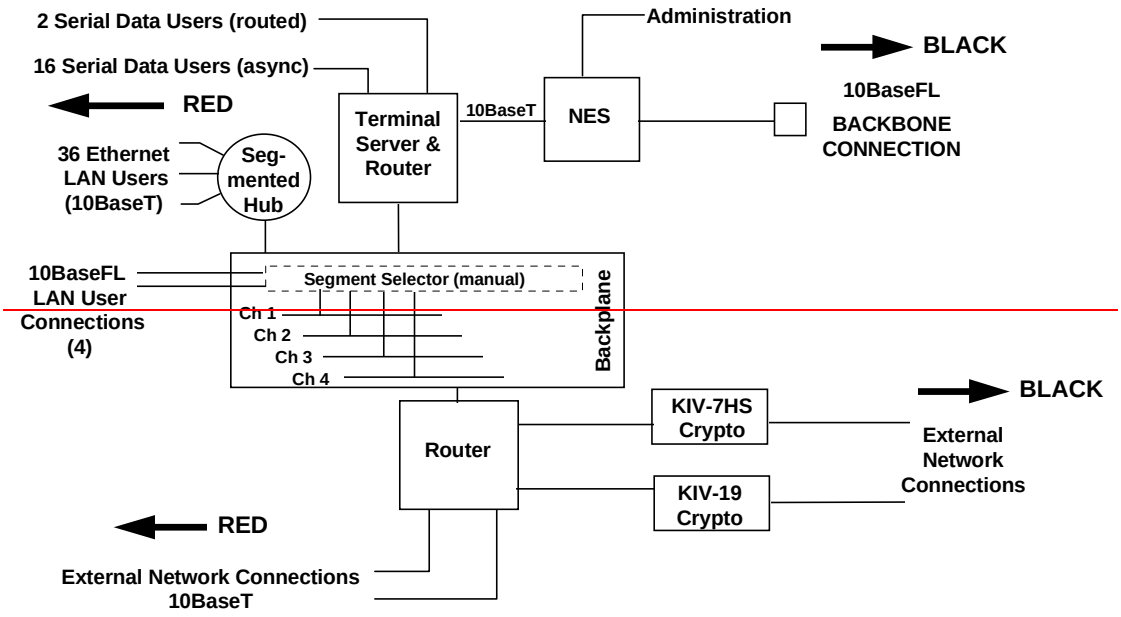


Figure 17: Red Hub Module, Functional Block Diagram

3.1.2.2.4 Red Router Module

The Red Router Module (Figure 18) provides Datagram Switched Network service for classified users. The module contains the same complement of equipment as the Red Hub Module. In addition, it includes a second router for direct connection to external red data networks via high-speed serial cryptos. The second router plugs directly into the seven-slot chassis backplane.



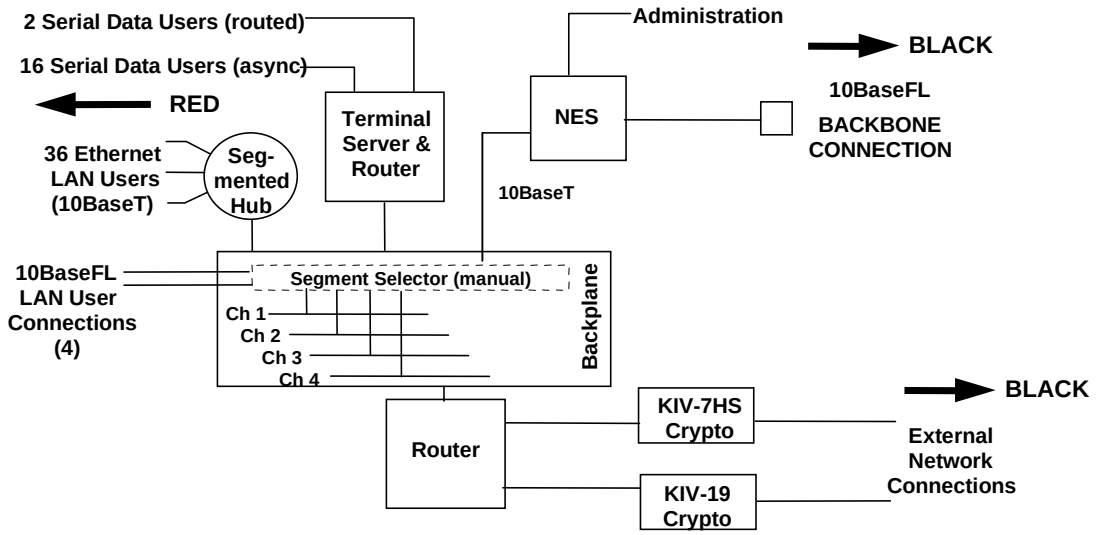


Figure 18: Red Router, Functional Block Diagram

3.1.2.2.5 Secure Voice Module

The Secure Voice Module has been redesigned and the STU III/R Module has been discontinued because the STU III/Rs are out of production. The Secure Voice Module now contains a voice switch configured with a MSU controller and 16 party and 8 party (or two four party) conference bridges to implement "meet me" secure conferencing capability (Figure 19). The sixteen party functionality may be subdivided into independent conferences as follows:

- One conference of up to 16 parties.
- Two conferences of up to 8 parties each.
- Three conferences of up to 8 parties, 4 parties and 4 parties each.

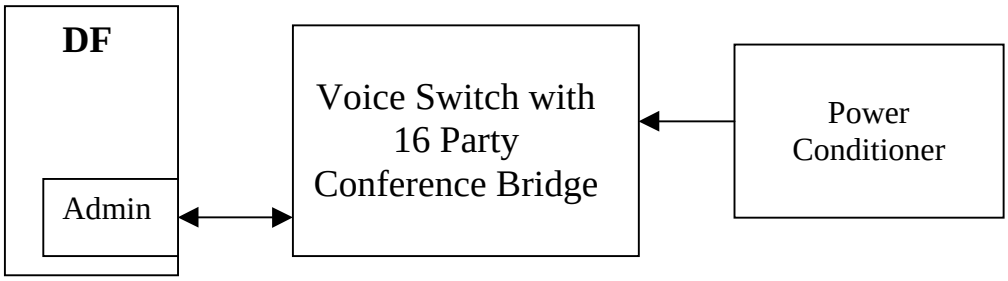


Figure 19: Secure Voice Module Block Diagram

3.1.2.2.6 Remote Distribution Frames

The remote data distribution frames (RDDFs) and remote voice distribution frames (RVDFs) permit multiple analog subscriber, digital subscriber and 10BaseT/100BaseTX LAN connections to be made from a user location to a module over a single cable. Remote distribution frames have the following features:

a. RDDFs provide six (6) RJ 45 female connectors on the subscriber end and module compatible connectors on the module end. RDDFs are used for 10BaseT/100BaseTX and ISDN BRI (digital subscriber) connections.
b. RVDFs provide six (6) RJ 11 female connectors on the subscriber end and module compatible connectors on the module end. RVDFs are used for analog subscriber connections.
c. Cable length of both units is approximately 150 feet. Individual Ethernet, ISDN and analog subscriber connections may be further extended using field fabricated "W5" and "W3" cables sets described in paragraph 3.1.2.1.1.

3.1.2.2.7 ISDN Terminal Adapters

The ISDN Terminal Adapters (TAs) permit the installer to establish internal network point-to-point (P-P) dedicated serial data connections via the SCN (Figure 20). Terminal adapters have the following features and characteristics:

a. Compatible with ISDN BRI (basic rate interface) channels (2B+D channels) provided by the Basic Access Module, Large Voice Module and Legacy PTT/Voice Module.
b. Integral keypad suitable to dial up point-to-point channels between any two points on the SCN.
c. Integral controls and display for configuration and status.
d. Connection for two data terminal equipment (DTEs) devices; EIA-232, EIA-366 and ITU V.35 interface capability.
e. Data rates of 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps asynchronous; 1200, 2400, 4800, 9600, 19200, 48000, 56000, 64000, 120000, 128000 bps synchronous.

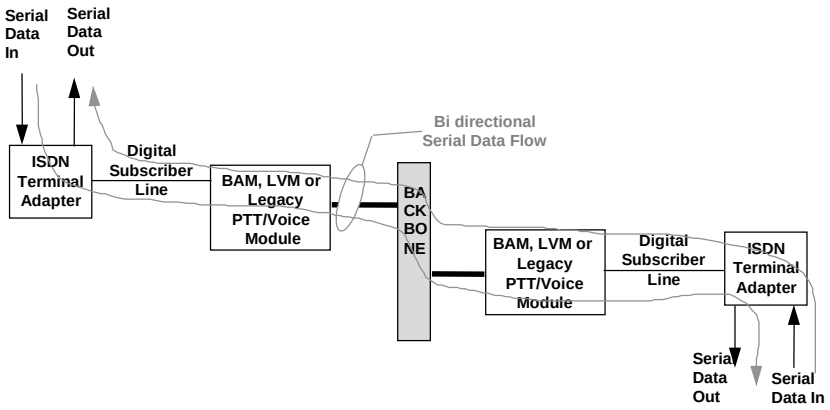


Figure 20: Two ISDN Terminal Adapters provide a point-to-point serial data connection.

3.1.2.2.8 Telephone Sets
TDC ICAP includes two-wire analog telephones that are electrically compatible with the analog subscriber ports on the Basic Access Module, Large Voice Module and Legacy PTT/Voice Module. These telephones shall have the following features and characteristics:

a. Single line 2-Wire Loop Start interface; female RJ-11 interface connector.
b. Dual tone multi-frequency (DTMF) dialing (EIA RS-470) with 12 button keypad (0 -9; *; #).
c. Powered from telephone line.
d. Adjustable ringer volume level.

3.1.2.2.9 DSVT Kit
DSVT Kit uses an interface card added to the switched network that permits KY-68 digital secure voice telephones to communicate point-to-point (Figure 21) or via long local loops to a legacy TRI-TAC switch. Each DSVT card supports up to four KY-68s operating at voice digitization rates of either 16 or 32 kbps.

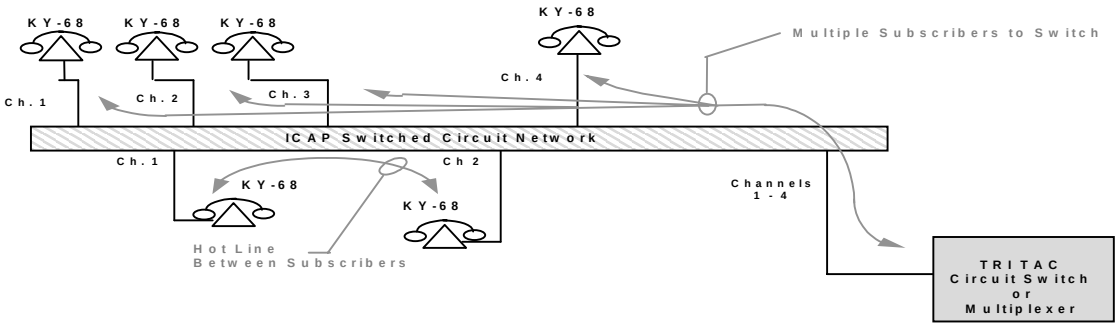


Figure 21: Typical KY-68 DSVT Interconnection Within TDC ICAP Network

3.1.2.3 Network Services.
The modules and components that fall within the network services category are used to manage the TDC ICAP network, provide off-base connectivity via TRI-TAC legacy terminals or the TDC light-weight multiband satellite terminal (LMST) and provide AUTODIN/DMS switched message service.

3.1.2.3.1 Large Voice Module (Legacy PTT/Voice Module)
The Large Voice Module (LVM) replaces the Legacy PTT/Voice Module (Figure 22) and can be configured to provide all functions that were provided by the Legacy module. The LVM provides connection between the SCN backbone and external switched circuit networks. The module can be configured to provide the following:

- SCN channel connections to secure push-to-talk (PTT) radios that may be used for dial-up UHF SATCOM connectivity.
- Analog FXO (foreign office exchange) trunks. These trunks may be used for a simple interconnection to 2-wire commercial telephone company (TELCO) subscriber lines anywhere in the world or to TRI-TAC switches with POTS 2-wire subscriber loops, and eight (8) E&M trunks for connection to compatible switching equipment.
- TELCO E-1, T-1 or ISDN PRI trunk connections .
- Four-wire analog connections for interface to AN/TTC-39 analog trunk types. Each connection being programmable to support AC supervision and DTMF signaling (Types 26 and 31), DTMF and Dial Pulse signaling (Types 34 and 48), MF 2/6 signaling (Type 36) and compatible with the trunk types provided in Table 2 and defined in MTR-84W00037. Type 26, 34, 36 and 48 trunks implement direct outward and inward dialing. The Type 31 and 44 trunks implement tie line (secondary dial tone received from legacy switch) functionality

The circuit switch in the LVM can be programmed to forward, to an attendant or other designated telephone, any incoming call that cannot be completed. All connections, except the Type 44 trunk, maintain AUTOVON multi-level preemption and priority throughout ICAP. Electrical connections are made using field fabricated cables (paragraph 3.1.2.1.1) attached to binding post interfaces with the legacy switch or intermediate loop group multiplexer analog appliqué units (AAUs).

Table 2: AN/TTC-39 SF Trunk Types Supported by TDC ICAP

Trunk Type	Characteristics	Legacy Switch		Signaling (Supervision)	Signaling (Address)
26	Analog Tone Burst	TTC-39 TTC-42	SB-3865 SB-3614A	Seize - 2250 Hz Release - 2600 Hz	DTMF 2/8
31	Tie Line	SB-3614		Seize - 2250 Hz Release - 2600 Hz	DTMF 2/8
34	Analog DSN PNID PBX access line	TTC-39 TTC-42	SB-3865 SB-3614A	SF Seize - no signal Release - 2600 Hz	DTMF - TX Dial Pulse - RX
36	Analog DSN; Non-confirmation signaling.	TTC-39		SF Seize - no signal Release - 2600 Hz	MF 2/6
44	Loop Start (DC closure)	TTC-39 TTC-42	SB-3614 SB-3614A	Incoming - 20 Hz ringing Outgoing - DC Loop	Dial Pulse DTMF
48	Analog DSN; PBX access line	TTC-39		SF Seize - no signal Release - 2600 Hz	DTMF - RX Dial Pulse - TX

The module includes an integral modem permitting its circuit switch to be administrated from a remote location.

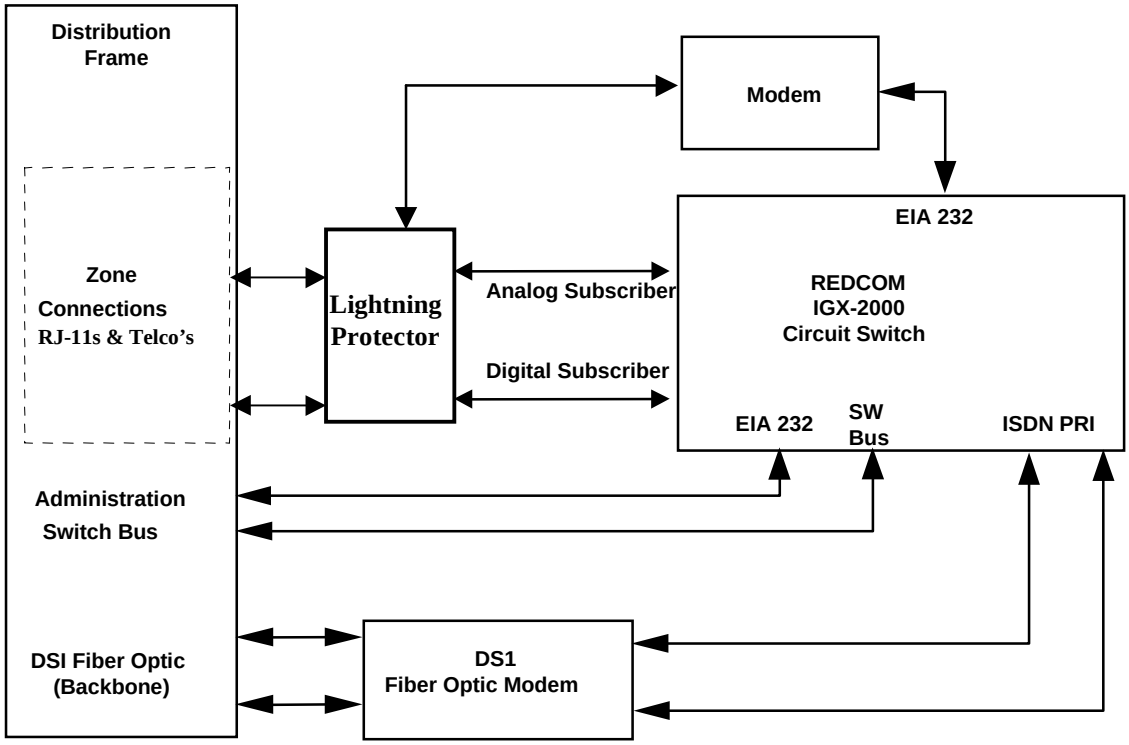


Figure 22: Large Voice Module, Functional Block Diagram

3.1.2.3.2 Promina MUX Module (P-MUX)
The Promina MUX Module multiplexes/demultiplexes Switched Circuit Network channels with Datagram Switching Network IP datagrams and auxiliary serial data channels to/from aggregate Promina compatible trunks.

The port side of the Promina MUX Module (Figure 23) provides two DS1 fiber optic backbone interfaces for connection to the SCN; 8 high-speed (HS) data interfaces (6 serial and 2 conditioned diphase) for connection to the Crypto Interface Module. The aggregate side of the MUX Module provides two Promina variable rate trunks (10 ms satellite buffer and 32 bit interleaver) with a configurable interface capable of either NRZ (non return to zero) or Conditioned Diphase signalling. A Promina TRK-3 is included for interconnection to other Promina MUX Modules. Module detail is found in the P-MUX Module Requirements Document.

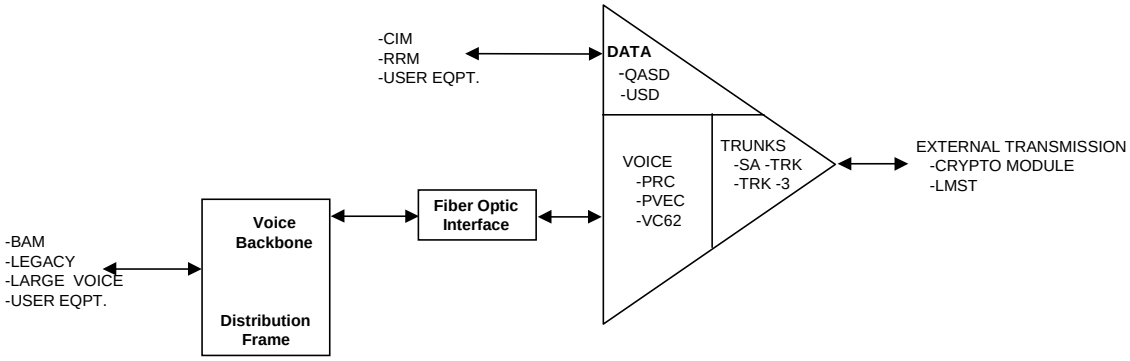


Figure 23: Promina P-MUX Module, Functional Block Diagram

Generally, one of the HS serial ports (USD) on the Promina P-MUX Module is used for input of a 64 kHz external timing reference. The timing reference, which is generated by a stratum 1 clock in the Crypto Module (paragraph 3.1.2.3.4), establishes the master clock reference for the SCN and for the HS synchronous serial interfaces (paragraph 3.2.1.7). In all configurations, one high-speed serial port is consumed by an external timing signal provided by the stratum 1 clock located in the Crypto Module.

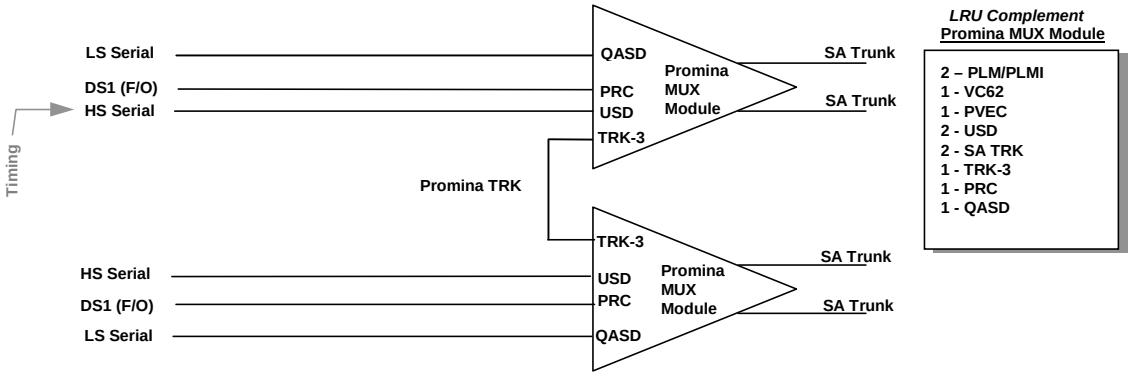


Figure 24: Promina P-MUX Compatible Multiplexer Interconnection Diagram

3.1.2.3.3 Uninterruptable Power Supplies

TDC ICAP includes two ~~a~~ kits for providing ~~of~~ uninterruptable power supplies (UPSs) which may be used when required to protect critical data from power brownout and total outages. The Small ~~Each~~ UPS Kit provides up to 450 watts of power (650 VA) and will sustain full-load for more than to 8 minutes following total loss of power. The Large UPS Kit provides up to 1050 watts of power (1500 VA) and will sustain full load for more than 5 minutes following total loss of power.

3.1.2.3.4 Crypto Module

The Crypto Module (Figure 25) provides four KIV-19 (KG-194 compatible) crypto devices for encryption/decryption of aggregate data channels that interface to legacy

communication terminals and the LMST. In addition, the module contains a GPS based primary reference source (PRS) for network timing which must be connected to the network via the Promina P-MUX Module when interfacing TDC ICAP digital trunks to external multiplexed networks. The PRS also provides an EIA-232 absolute time output that may be used by the Datagram Switched Network for time of day network services.

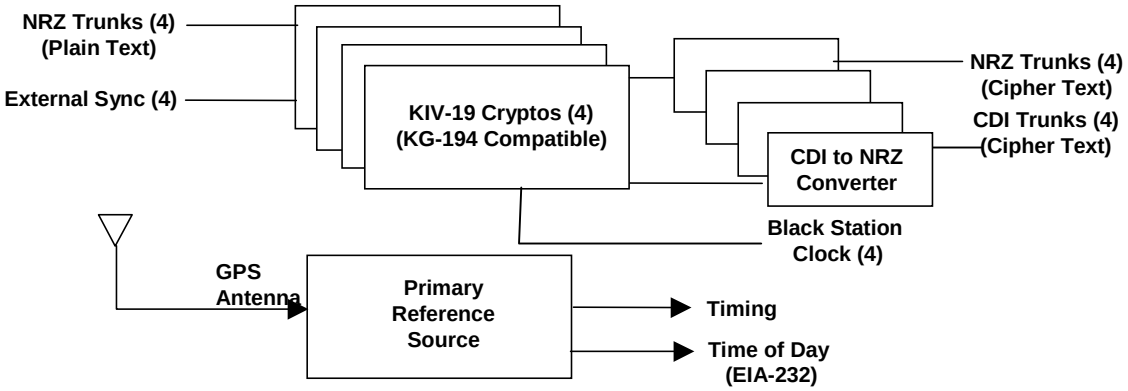


Figure 25: Crypto Module, Functional Block Diagram

The Crypto Module includes four NRZ to CDI converted channels. Each converter provides for input of Black NRZ signals from the KIV-19 and CDI outputs over CX-11230 compatible connectors. For secure communication, the NRZ trunk connectors on the Promina P-MUX Module interface to the NRZ DTE connectors on the Crypto Module. Both NRZ and CDI cipher text interfaces are available on the Crypto Module for interface to communication terminals (Figure 26). Patch panels are provided to facilitate the selection of NRZ or CDI interfaces.

Non-secure serial connectivity is accomplished by using the baseband patch panels in the Crypto Module to bypass the KIV-19 encryptors.

For Crypto loopback, the integrated baseband patch panels provide maximum flexibility for various requirements.

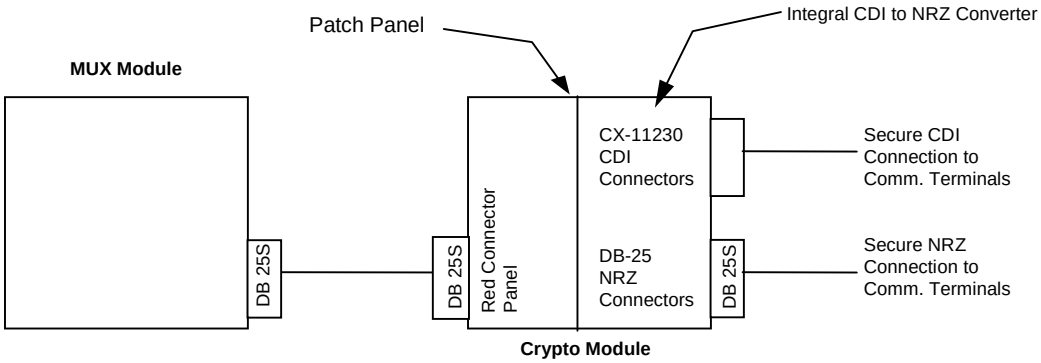


Figure 26: Secure Reachback/STEP Connection

Module detail is found in the Crypto Module Requirements Document.

3.1.2.3.5 AN/FCC-100 Multiplexer

The AN/FCC-100(V)7/8/9 (Figure 28) provides a bridge between TDC-ICAP and external legacy AN/FCC-100 multiplexer supported systems. It multiplexes/demultiplexes Switched Circuit Network channels with Datagram Switching Network IP datagrams and auxiliary serial data channels to/from an aggregate AN/FCC-100 compatible trunk. The AN/FCC-100 interfaces to the Datagram Switching Network via a Crypto Interface Module serial data channel. The interface to the SCN is accomplished via FXO or E & M trunks in the Legacy/PTT Voice Module. The FXO trunks are used when it is necessary for the FCC-100 to provide echo cancellation such as when there are two wire telephones at the other end of a satellite communications channel. Table 3 provides the configuration of the TDC ICAP's AN/FCC-100 (V)7/8/9.

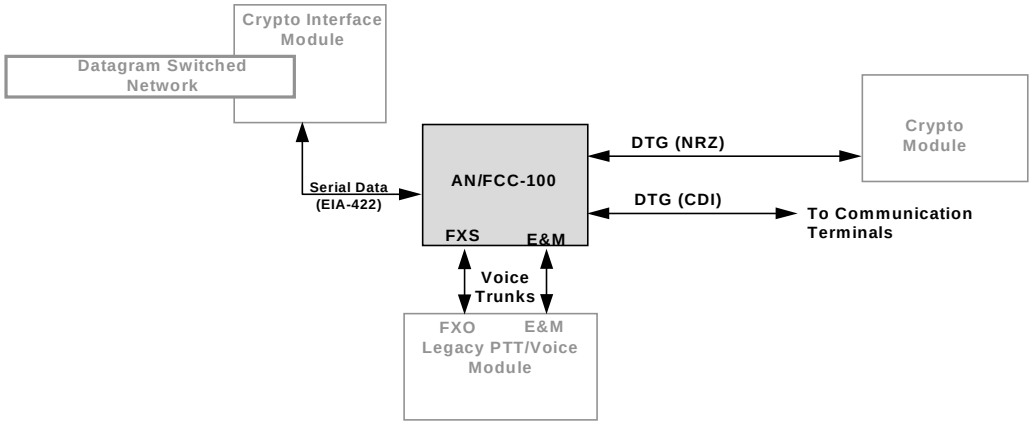


Figure 28: AN/FCC 100 Multiplexer Application within TDC-ICAP

Table 3: AN/FCC 100(V7/8/9) Multiplexer Configuration for TDC ICAP Compatibility

Function	Module	Module Appliqué
Port Interface	Universal Dual Port Carrier	Synchronous Digital Interface (Balanced)
	Dual VF FXS Interface	CELP/STU-III Compression Appliqué
		CELP/FAX/Modem Compression Appliqué
	Dual VF 4-Wire E&M Interface	CELP/STU-III Compression Appliqué
		CELP/FAX/Modem Compression Appliqué
Aggregate	Aggregate Carrier TRI-TAC/NRZ	RS-422/RS-423 Driver or High Speed

Interface		TRI-TAC Driver (user selectable)
Options	Single tactical enclosure	
	CX-11230 connectivity	

3.1.2.3.6 Message Terminal Module

The Message Terminal Module (Figure 29) provides a CGS-100 terminal, which may be used to compose, receive and switch AUTODIN message traffic. The module includes two integral KIV-7HS cryptos, a two port ISDN terminal adapter and two conditioned diphase (CDI) wireline adapters. The EIA 232 and digital subscriber connections for black protocol data permit the CGS-100 to be connected directly or remotely via the SCN to the Promina P-MUX or AN/FCC-100 multiplexers for reachback interface to AUTODIN or a remote AN/TYC-39 (Figure 30). An Ethernet interface enables the CGS-100 to be connected directly to the Switched Datagram Network via a Red Hub or Red Router Module. The balanced CDI interface permits the CGS-100 to be connected directly to a local AN/TYC-39 or AUTODIN Message Switch. The Message Terminal Module may also be operated with external cryptos and terminal adapters to implement a local switched message network within TDC ICAP (Figure 31). In this application, user AUTODIN terminals are interfaced via the SCN to the remaining protocol ports on the CGS-100 using external KG 84s and ISDN TAs.

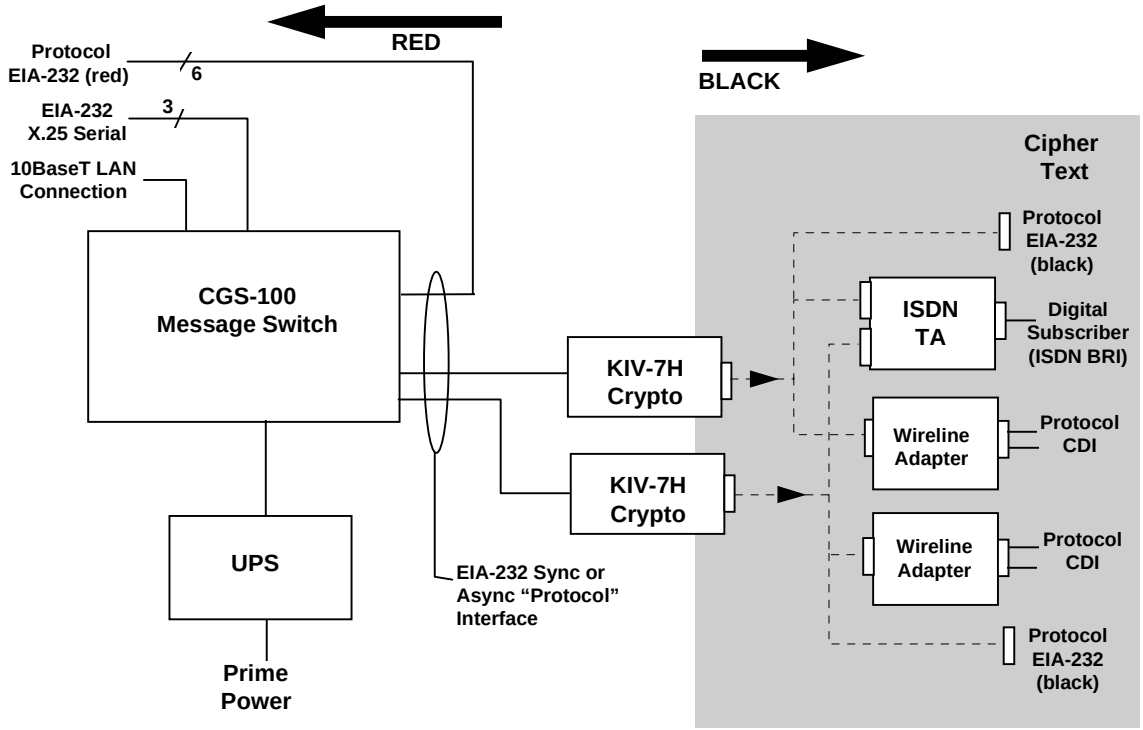


Figure 29: Message Terminal Module, Functional Block Diagram

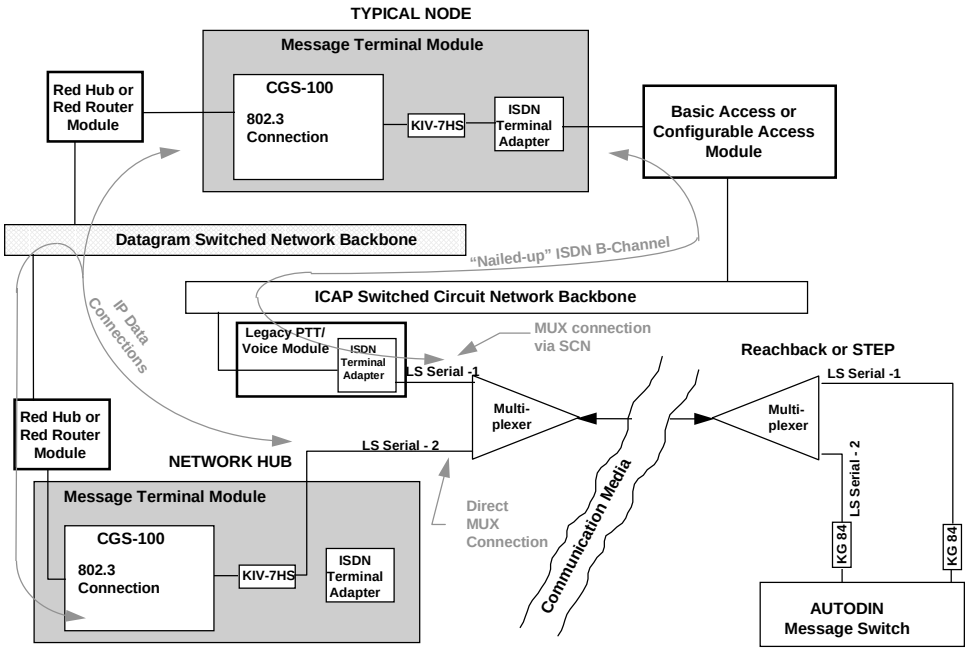


Figure 30: Message Terminal Module, Network Interconnections

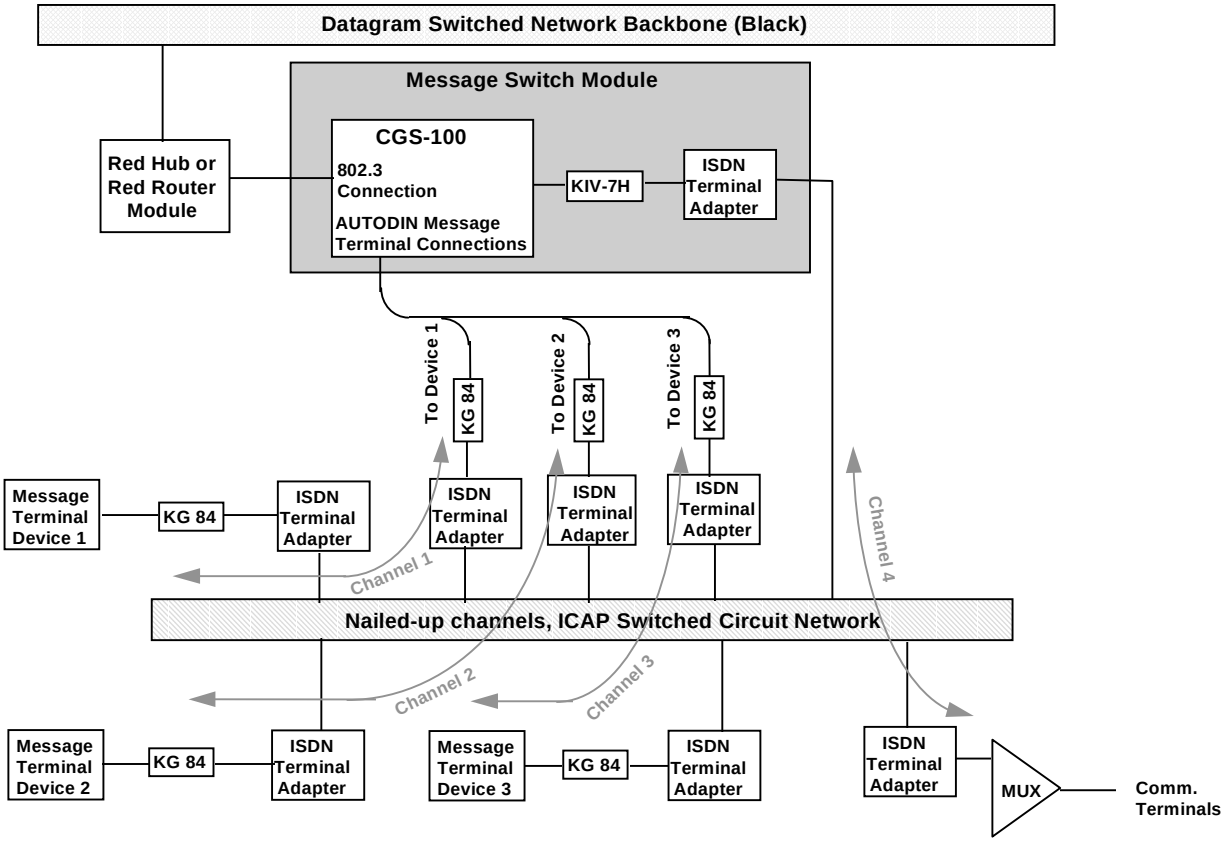
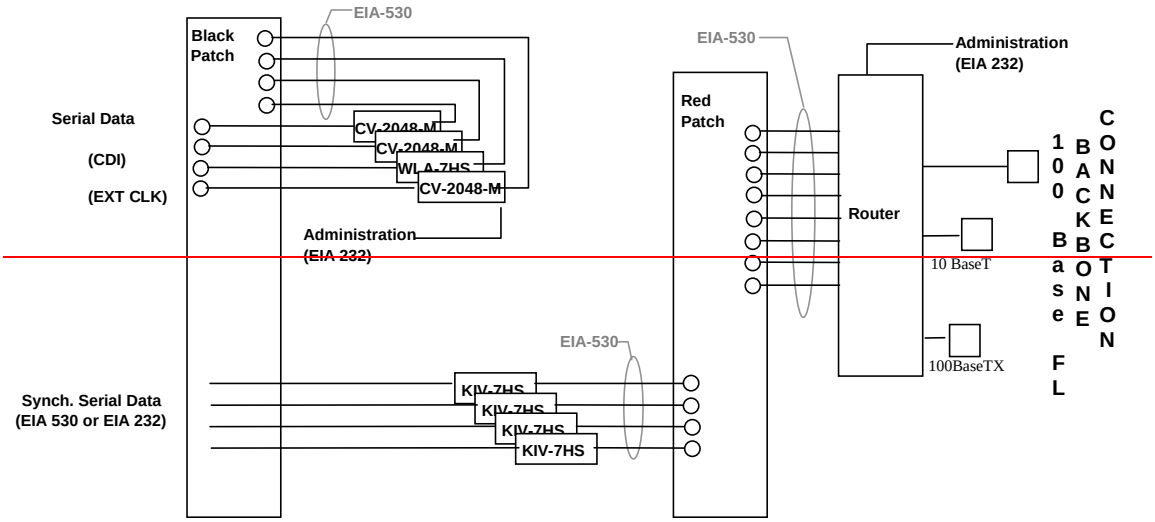


Figure 31: Switched Message Network within TDC ICAP

3.1.2.3.7 Crypto Interface Module (CIM)/Crypto Interface Module v2 (CIM V2)

The Crypto Interface Module has been upgraded and the upgraded module is designated as CIM v2. The text will point out the differences where required.

The Crypto Interface Module v2 (Figure 32) provides IP routing and encryption of data packets on the Datagram Switched Network. The primary function of the CIM and CIM v2 is to switch (route) IP datagrams between the Datagram Switched Network and individual serial channels, which are interfaced to external IP networks such as NIPRNET. The module includes KG-84 compatible crypto (KIV-7HS) to interface with serial networks and systems having these same communication security devices. Four channels of KIV-7HS encrypted data and four channels of KIV-19 encrypted data are provided in the CIM. The CIMv2 provides 4 channels of KIV-7HS encrypted data. ~~each data type are provided~~. In addition, the CIM v2 includes two (wired for four) conditioned diphase high-speed wireline adapters (WLAs) to enable direct interface1.2 kbps to 2,048 digital channels on TRI-TAC multiplexer equipment and circuit switches. In addition, the WLAs (CV-2048-M) has external clock inputs in addition to internal clock generators enabling two CIM v2s to be interconnected via secure wireline (up to 2,048Kbps) to act as a bridge between IP networks. Module detail is found in the Crypto Interface Module v2 Requirements Document. The second pair of CV-2048s shown in gray in Figure 32 are wired in but not provided with the module.



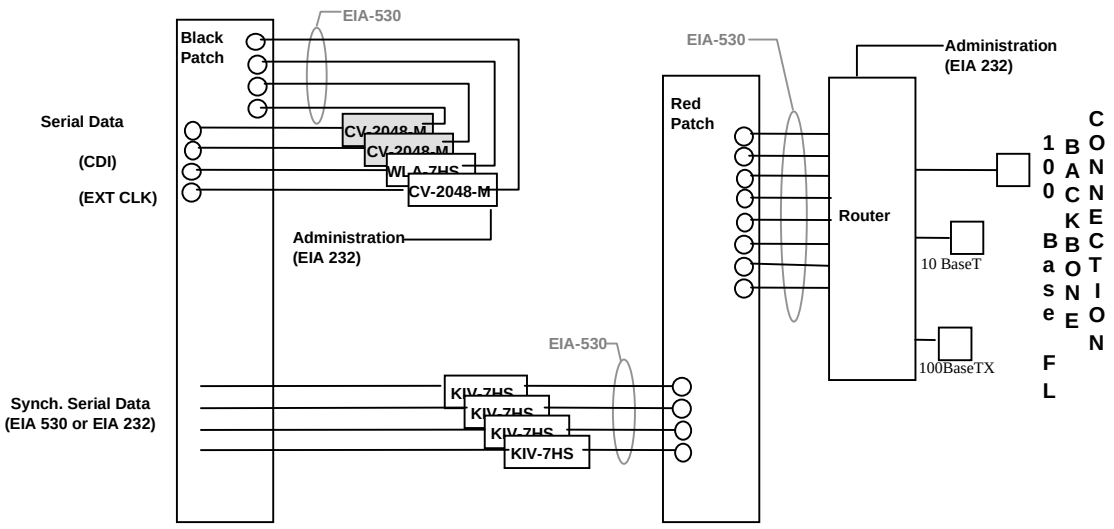


Figure 32: Crypto Interface Module v2, Functional Block Diagram

3.1.2.3.8 Network Management Modules

TDC ICAP contains two network management platforms, Network Management Terminal -Ultra (NMT-U) Module and Network Management Terminal - Pentium® (NMT-P) Module. These two modules are configured with different sets of software to implement the five distinct functions provided in Table 4. A typical interconnection of these modules within TDC ICAP is presented in Figure 33.

Table 4: Network Management Terminal Functions

Module Function	Common Name	Platform
Network Security	Firewall	NMT-P
Circuit switch management	Circuit Switch Management Terminal (CSMT)	NMT-P
Network application server (red or black)	Server	NMT-P
Datagram Switched Network manager (red or black)	Network Management Terminal (NMT)	NMT-U
Multiplexer management	Panavue Mux Manager	NMT-U

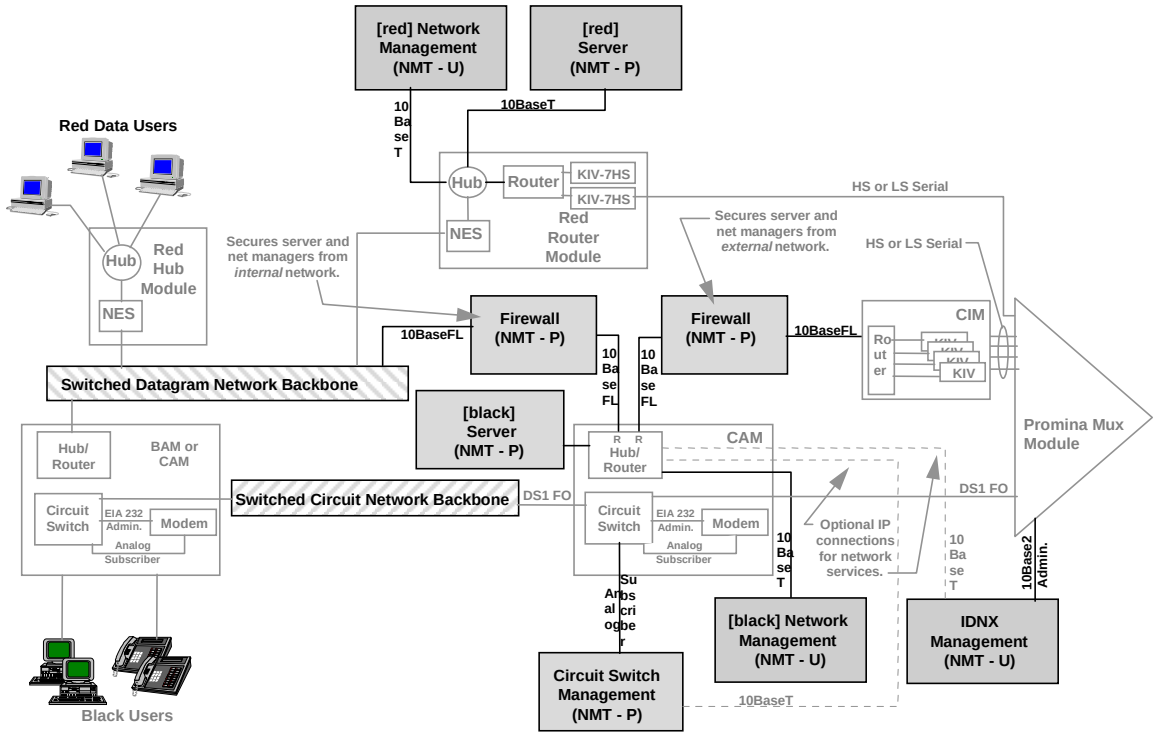


Figure 33: Network Management within TDC-ICAP

a. Network Management Terminal - Ultra Module

The NMT-U Module is a SPARC based platform implemented by a 170 MHz Sun Ultra 1 computer with a standard complement of peripheral devices (Figure 34). The module includes a built-in flat panel display and keyboard with an integral-pointing device. An uninterruptable power supply is included within the module to provide short-term continuous power in case of power failure or brownout. The module interfaces to the network via a single 10BaseT Ethernet connection.

The NMT-U Module's Solaris operating system (UNIX) includes the following standard features:

- Security -- Password protection; login-in attempts/successes file; successive log-in delay.
- Remote Access -- Telnet; Zmodem, Xmodem, Kermit applications allowed.
- E-Mail
- File Transfer -- FTP
- News -- NNTP/UUCP
- Network Time -- NTP
- Directory Services -- Finger; whois

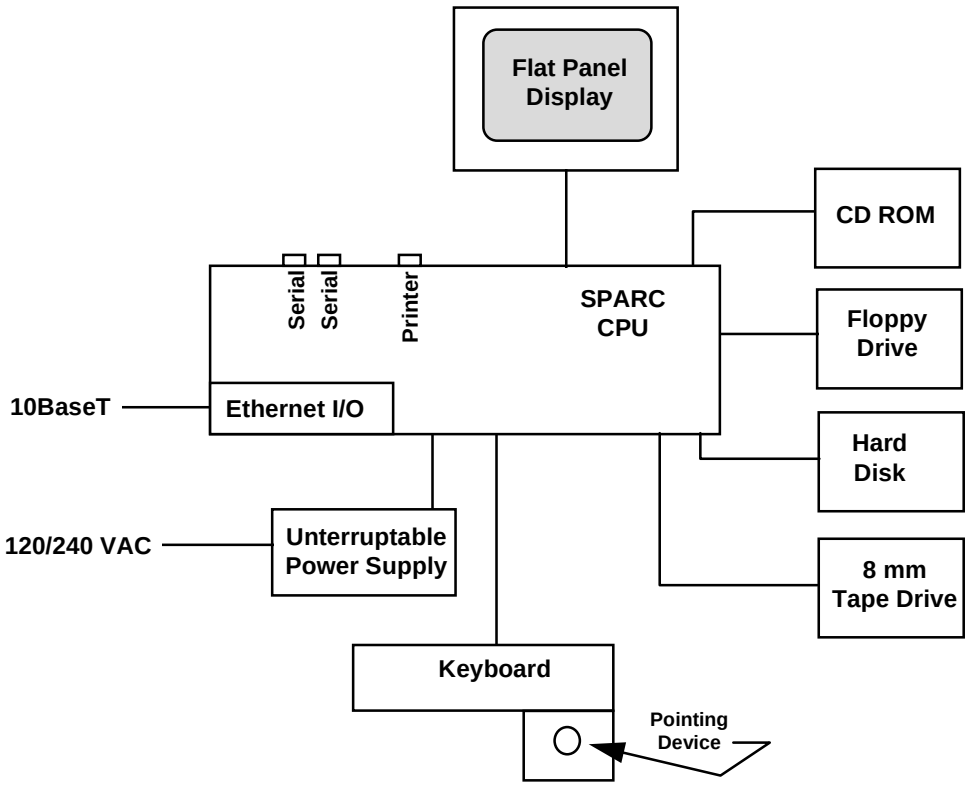


Figure 34: Network Management Term. - Ultra, Functional Block Diagram

b. Network Management Terminal - Pentium® Module

The NMT-P Module is a WindowsNT™ based platform implemented by dual 200 MHz Pentium-Pro® processors with a standard complement of peripheral devices (Figure 35). The module includes a built-in flat panel display and keyboard with an integral-pointing device. A uninterruptable power supply is included within the module to provide short-term continuous power in case of power failure or brownout. The module's CPU includes two independent Ethernet interface cards. Each card provides 10BaseT and 10BaseFL network connections. In addition, the module contains an internal modem, which enables dial-up of the administrative circuit switch ports in the Basic Access, Configurable Access and Legacy PTT/Voice Modules.

The NMT-P Module's WindowsNT operating system includes the following standard features:

- Security -- Password protection; login-in attempts/successes file; successive log-in delay.
- Remote Access -- Telnet; Zmodem, Xmodem, Kermit applications allowed.

- E-Mail
- File Transfer -- FTP
- Web Access -- HTTP
- News -- NNTP/UUCP
- Network Time -- NTP
- Directory Services -- Finger; whois

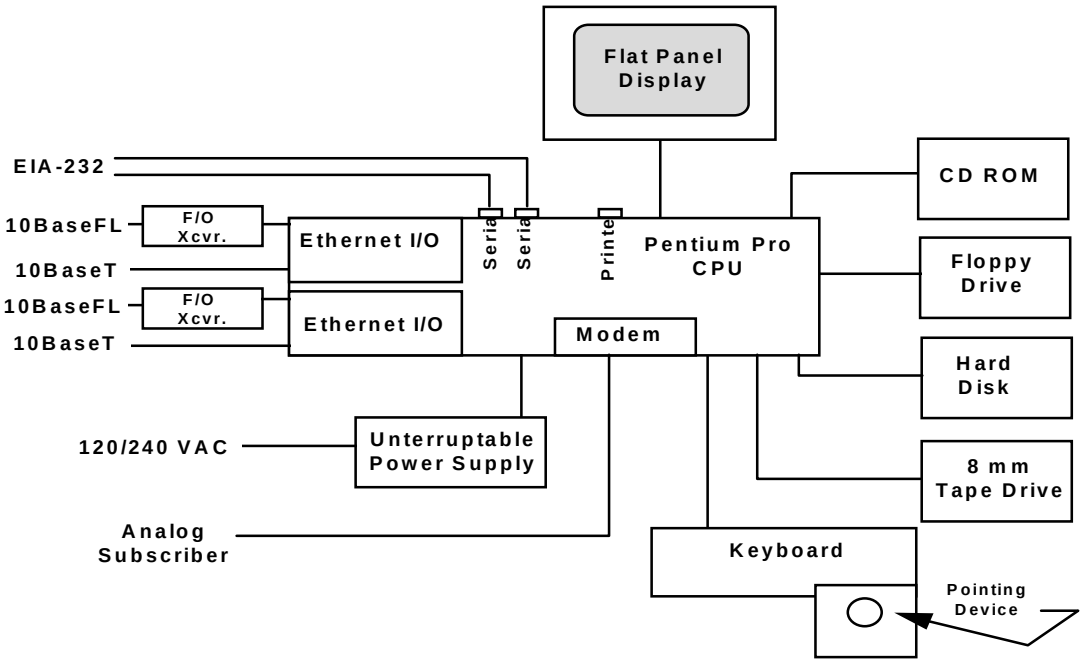


Figure 35: Network Management Term. - Pentium®, Functional Block Diagram

c. Network Management Terminal Function

The Network Management Terminal (NMT) is implemented with an NMT-U Module running the Hewlett Packard OpenView® network management application. The NMT provides the operator interface for managing the configuration and monitoring the activity of the SNMP (Simple Network Management Protocol) devices on the TDC ICAP Datagram Switched Network (Table 5). Individual NMTs are required for black and red networks.

Table 5: SNMP Managed Components on the TDC ICAP Network

Component	Module

Terminal Server	Basic Access Module; Large Voice Module; Red Router Module; Red Hub Module
Ethernet Switch	Basic Access Module; Large Voice Module
Hub	Basic Access Module
Enterprise Hub	Large Voice Module; Red Router Module; Red Hub Module
Router	Red Router Module; Crypto Interface Module
Promina 400	Promina P-Mux Module

d. Multiplexer Management Function

The Panavue Mux Manager is implemented with an NMT-U Module running the NET Panavue network management application. The Panavue interfaces directly to the 10Base2 Ethernet ports on the Promina Server Module Interface (PSMI) to enable the operator to manage the multiplexer configuration and monitor channel activity.

e. Circuit Switch Management Function

The Circuit Switch Management Terminal (CSMT) is implemented with an NMT-P Module set up in a terminal emulation mode. The CSMT interfaces to each network circuit switch over the SCN via a dial-up connection between its internal modem and an administrative modem connected to the administration port of the circuit switches contained in the BAM, LVM and Legacy PTT/Voice Modules. The CSMT enables the circuit switch administrator to configure each switch and monitor its status.

Two levels of security may be programmed into the network to ensure that an unauthorized person cannot dial into a network switch and change its configuration. The first level is accomplished by programming the administrative modem's Analog Subscriber port on each circuit switch to accept calls only from the telephone number assigned to the CSMT. Second, each administrative modem may be programmed with a unique password to gain access.

f. Firewall Function

The Firewall is implemented with an NMT-P Module running Secure Computing Group's "Sidewinder" firewall application. The firewall provides a client authentication function that restricts network access on the other side to specified users only. In addition, the firewall application has anti-spoofing protection and provides alerts to identify suspicious communication. The firewall includes Proxies to modify acceptance criteria for incoming e-mail and uses "type-enforced" SMTP to close sendmail security holes.

TDC ICAP is generally deployed with two firewalls as previously illustrated in Figure 33. One of the firewalls is configured to protect the network from outside access. The second firewall protects the network servers and network managers from inside the

network as well. The external firewall provides domain name service (DNS) for the network.

g. Server Function
The Server is implemented with an NMT-P Module running components of Microsoft BackOffice software. The server provides e-mail services and SQL storage and retrieval services. In addition, the server provides *intranet* services for the TDC ICAP network. Individual servers are required for red and black networks.

3.1.2.3.9 Laptop Personal Computer (PC) Terminals
TDC ICAP includes laptop PC Terminals which may be used for the local configuration and management of both non-SNMP network components (Table 6) and SNMP managed devices. Each PC is configured as a VT-100 terminal emulator and may be connected directly to each managed device. During installation, the installer will use the PC Terminals locally to initially configure each module to get the network up and running. Once the network is operational, sustained management is accomplished primarily from the centralized network management and component management terminals.

Table 6: Non-SNMP Managed Devices

Device	Module
Circuit Switch	Basic Access Module; Large Voice Module; Legacy/PTT Voice Module
Admin. Modems (passwords)	Basic Access Module; Large Voice Module; Legacy/PTT Voice Module
CGS-100	Message Switch Module
AN/FCC-100 Multiplexer	Standalone
ISDN Terminal Adapter	Message Switch Module; Standalone

3.1.2.4 Expanded Module Capability
The functionality of several modules may be expanded in the field with the addition of LRUs, which are available as configuration kits. ~~ICAP includes "Basic" and a "Force Level" kits which differ only in the number of LRU therein. Each configuration kit is packaged in a set of transit cases with foam cutouts for each of the specialized LRUs.~~ Tables 7-1 through 7-30 lists the configuration kits which can be used for module enhancement, troubleshooting, testing and repair.~~, 8, 9 and 10 list the items contained in each kit.~~

Table 7: Configuration Kits, Datagram Switch Network Items

Qty. (Force)	Qty. (Basic)	Item	Modules Used In	Function
6	2	8 port 10BaseT Ethernet switch with AUI port.	NA	Provide the capability to segregate user LANs and workstations.
20	6	10BaseFL AUI Transceivers	NA	Provides optical fiber connectivity to Ethernet hub or switch.
8	2	10Base2 AUI Transceivers	NA	Provides 10Base2 connectivity to Ethernet hub or switch.
6	2	8 port dumb 10BaseT hub with AUI port.	NA	Provide capability to establish user LANs and/or connect additional workstations.
6	2	Single port 100BaseFL plug-in.	BAM	Plugs into module's Ethernet switch to provide high-speed 100BaseFL interface connection.
2	1	Plug-in hub with 36 10BaseT connections.	LVM Red Hub Red Router	Plugs into module's enterprise hub backplane to increase the number of 10BaseT connections.
2	0	Plug-in hub with 24 10BaseT and two 100BaseT connections.	LVM Red Hub Red Router	Plugs into module's enterprise hub backplane to increase the number of 10BaseT connections and add 100BaseT connections.
1	0	Plug-in interface with two FDDI connections.	LVM Red Hub Red Router	Plugs into module's enterprise hub backplane to provide connections to FDDI networks.
12	6	ISDN Terminal Adapter	NA	Provides EIA-232 and V.35 conversion to ISDN BRI.

Table 8: Configuration Kits, Switched Circuit Network Items

Qty. (Force)	Qty. (Basic)	Item	Modules Used In	Function
6	2	2 port T1/DS1 Fiber Optic Modem	NA	When used in pairs, enables switched circuit network backbone to be extended over twisted pairs of copper wire rather than fiber.
12	4	Dynamic Line Circuit Card	BAM LVM Legacy PTT/Voice	Plugs into circuit switch to increase the number of analog subscriber lines (16 per LRU).
8	2	ISDN Basic Rate U Interface Card	BAM LVM Legacy PTT/Voice	Plugs into circuit switch to increase the number of digital subscriber lines (4 per LRU).
4	2	16 Party Conference Card	BAM LVM Legacy PTT/Voice	Plugs into circuit switch to provide a single 16 party conferencing capability.
2	1	8 Party Additive Conference Card	BAM LVM Legacy PTT/Voice	Plugs into circuit switch to provide an additional 8 party or dual 4 party conferencing capability.
4	2	Secure Radio Interface Card	BAM LVM Legacy PTT/Voice	Plugs into circuit switch to provide an interface for a secure push-to-talk radio.
1	0	E1 Interface	Legacy PTT/Voice	30 channel digital trunk interface to European TELCO.
1	0	R2 Signalling	Legacy PTT/Voice	Provides signalling for E1 trunks
8	4	SF Signalling Trunk Interface	BAM LVM Legacy PTT/Voice	Provides analog trunk connections to legacy TRI TAC switches (2 per LRU)
4	1	GSRD/LSRD Trunk	BAM LVM Legacy PTT/Voice	Provide additional FXO trunks for interface to commercial TELCO (2 per LRU).

Table 9: Configuration Kits, Promina Multiplexer (P-MUX)

Qty. (Force)	Qty. (Basic)	Item	Modules Used In	Function
4	2	USD Front Cards	Promina Mux	Plugs into IDNX 20 to provide 2 additional synchronous serial data ports.
2	1	QASD Front Card	Promina Mux	Plugs into IDNX 20 to provide 4 additional low speed serial data ports.
1	1	CDI Rear Card	Promina Mux	Used with USD front cards to provide balanced CDI interface.
5	2	EIA 530 Rear Card	Promina Mux	Used with USD front cards to provide balanced NRZ interface.
2	1	QAVP Card	Promina Mux	Plugs into IDNX 20 to provide 4 analog voice ports
2	1	48 volt DC power card	Promina Mux	Provides power to QAVP connected analog telephones.
2	0	PRC Card with DS1 rear card	Promina Mux	Plugs into IDNX 20 to provide T1 trunk interface.

Table 10: Configuration Kits, Crypto Items

Qty. (Force)	Qty. (Basic)	Item	Modules Used In	Function
16	4	6 foot EIA-232 to KG-84 Cable	NA	Required to connect EIA 232 ports to red side of user provided KG-84A crypto units.

Table 7-1 Fiber Cable Kit 67-P50015H001

The Fiber Cable Kit includes the tools and supplies necessary to build and repair fiber cables.

Item Description	Source	Part #	Qty.
B-Series Tactical Fiber (3 pair) – 1500 meter spool	Optical Cable Corp	B006-085C-W3EB/1UC	1
Fiber connector tool kit [1]	Blackbox	FT-535-R2	1
Installation tool/bench clamp (p/o kit)			--
Crimp tool (p/o kit)			--
Fiber Optic cleaver (p/o kit)			--
Buffer tube stripper (p/o kit)			--
Ruler, gauge, scissors, tape (p/o kit)			--
Mechanical 6-splice tray	Blackbox	WP602	4
Pre-Polished fiber connector (SC)	Blackbox	F0032	20
Pre-Polished fiber connector (ST)	Blackbox	F0031-R2	40
No adhesive mechanical splice (6 ea.)	Blackbox	F0030	5

Note 1: Contractor procures only the Fiber connector tool kit, P/N FT-535-R2. The part numbers of the components inside of the kit are not controlled by this document.

Table 7-1 Voice/Data Cable Kit 67-P50016H001

The Voice/Data Cable Kit includes the tools and supplies necessary to build and repair 10/100 BaseT cables.

Item Description	Source	Part #	Qty.
Category 5 Twisted Pair (1000' box)	Berk-Tek	530577-TP	3
Crimp Tool kit	Blackbox	FTM600	1
Amp RJ11 plug (100 pack)	Blackbox	FM020-100PAK	2
Amp RJ45 plug (100 pack)	Blackbox	FM110-100PAK	2
Label Sheets (package of 50)	Blackbox	FT931	4

Table 7-2 Bar Code Kit 67-P42995D001

The Bar Code Kit includes the equipment and supplies that are used for making and reading Bar Code labels.

Item Description	Source	Part #	Qty.
Bar Code Reader	Intermec	J2020D311100	1
Barpen 1280 series Wand Scanner	Intermec	1283B02XX	1
Communications Dock	Intermec	JD2020C	1
Universal Power Supply	Intermec	058399	1
PCMCIA S-RAM Card	Intermec	058744	1
User Manual	Intermec	065715	1
Spare Battery Pack	Intermec	065557	1
Interlink Cable	Intermec	047569	1
Thermal Transfer Printer	Intermec	3240B0110000	1
Printer Serial Null Modem Cable	Intermec	048693	1
3240 Printer User's Manual	Intermec	063015	1
Ribbon premium 2.8" X 6000"	Intermec	13062806	4
Bar Code Material 2" X 5" Gloss white Ploy	Intermec	E15934	1
Bar Code Material 1.438" X 5" Gloss white ploy High Tack Adh	Intermec	E15935	1
Bar Code Material 1.5" X .25" Gloss white ploy High Tack Adh	Intermec	E15936	1
Bar Code Software Disk	Intermec	98-P43305D001K	1 set
Wand Cable with 10 pin connector	Intermec	069444-002	1
Software Control Drawing	Motorola	98-P43305D	1
Kit Sub-Assembly	Motorola	15-P42982D016	1

Table 7-4 Cable Maintenance Kit 67-P43027D001

The Cable Maintenance kit includes equipment necessary for the maintenance, testing and trouble-shooting of the various types of cables used in the TDC-ICAP system.

Item Description	Source	Part #	Qty.
Fiber Optic Time Domain Reflectometer	Tektronix	TFS3031-03-024	1
Cable Tester	Tektronix	TS100	1
ISDN Craft Handset	Tektronix	CT100	1
HP Digital Average Pwr Mtr	Hewlett -Packard	E4418B	1
HP Power Sensor	Hewlett -Packard	8481B	1
Patch Cord	Noyes	8700-00-003	1
Coupling	Noyes	8400-00-0022	1
Digital Multimeter with Accessories	Fluke	FLUKE-27/AN(CE)	1
Noyes AC Adapter	Noyes	4050-00-0101	1
Craft handset	Alltell Supply	MLP1-2-ST	1
Fiber Optic Multimode	Alltell Supply	22801-009	1
RS530 Breakout Box	International Data Sciences	Blue Box 530	1
Oscilloscope	Tektronix	THS720A	1
Kit Sub-Assembly	Motorola	15-P42982D007	1

Table 7-5 Circuit Extension Kit 67-P50017H001

Extends digital services (T1/E1) over fiber and unconditioned copper lines.

Item Description	Source	Part #	Qty.
Pairgain CAMPUS RS	Pairgain	150-1158-01	2
Campus Flex RS	Pairgain	150-1173-51	2
Campus Rex RS	Pairgain	150-1175-51	2
T1/E1 Fiber line driver	Blackbox	MT611A-ST	2
CV-2048 Modem	DNE	97340023	2

Table 7-6 Crypto Configuration Kit 67-P50018H001

Additional Trunk Encryption Units.

Item Description	Source	Part #	Qty.
Serial Encryption Unit	Mykotronx	4070580-0501	2
Standalone KIV-7 Power Supply	Mykotronx	4065539-0701	2
RS-530 KIV-7 RED interface cable	Mykotronx	4074249-0501	2
RS-530 KIV-7 Black interface cable	Mykotronx	4074250-0501	2

Table 7-7 Router Kit 67-P50019H001

Additional Router Unit Less serial and fiber cables

Item Description	Source	Part #	Qty.
Router	Cisco	CISCO3640	1
IOS Software	Cisco	S364AL-12.0.7T	1
10/100BaseFX card	Cisco	NM-1FE-FX	1
10/100BaseTX card	Cisco	NM-1FE-TX	1
Serial interface card	Cisco	NM-4T	1
16MB Flash Upgrade	Cisco	MEM3600-8U16FS	1
DRAM Memory Upgrade	Cisco	MEM3640-32U64D	1

Table 7-8 LAN Kit 67-P50020H001

Additional Hubs, category 5 / fiber media converters and GPS Network Time Server.

Item Description	Source	Part #	Qty.
8-port autosensing 10/100 managed, stackable repeater	Cisco	CISCO1538M	4
8-port autosensing 10/100 managed switch	Cisco	CISCO1548M	4
5-port unmanaged (dumb) hub	Allied Telesyn	AT-FH705E	2
Network Time Server	Truetime	NIC-315	2
10Base2 to 10BaseT Media Converter	Transition Networks	E-CX-TBT-04	2
10/100BaseTX to 100BaseFX Bridging Media Converter	Transition Networks	E-PSW-FX-03	10
10BaseT to 10BaseFL Media Converter	Transition Networks	E-TBT-FRL-04	4

Table 7-9 Echo Cancellation Kit 67-P50021H001

Optional echo cancellation hardware to reduce echo at the P-MUX.

Item Description	Source	Part #	Qty.
Duo DiGroup Enclosure 2U, (for 2 cards)	Tellabs	EC-6111A-G	1
Dual AC Power Supply (90-240V)	Tellabs	EC-6241A-1	1
Handheld Controller (for setup)	Tellabs	HC-1062A	1
T1 Echo Canceller Card	Tellabs	EC-64218-E0CMA	1
E1 Echo Canceller Card	Tellabs	EC-63218-E0BMA	1

Table 7-10 PMux Voice Kit 67-P50022H001

Optional interface cards used within the P-MUX.

Item Description	Source	Part #	Qty.
PRC card w/DS1 interface	NET	3030B	2
FXS card	NET	PVAFXS	1
VC62 Voice Compression Card	NET	4040A	1
VC FAX/12 card	NET	004114A	1

Table 7-11 Port Interface Kit 67-P50023H001

Serial and CDI interface cards used within the P-MUX.

Item Description	Source	Part #	Qty.
USD Module w/EIA-530 DCE	NET	5035B	2
QASD Module w/EIA-530	NET	5019B	1
HSD-2+ Module w/EIA-530	NET	5765B	1
RS232 Rear Card	NET	9014B	1
Conditioned DiPhase Rear Card	NET	9079B	2

Table 7-12 Trunk Interface Kit 67-P50024H001

Serial interface cards used within the P-MUX.

Item Description	Source	Part #	Qty.
CEPT TRK Module	NET	2090B	2
SA TRK w/EIA-530	NET	2230B	1
RS422 TRK	NET	2071B	1
DSX-1 interface card (T1)	NET	2511B	1
TRK 3 Front card	NET	2503B	1
STI EIA 530 interface card	NET	2515B	1

Table 7-13 Fireberd Analyzer Kit 67-P50025H001

Contains the Fireberd 6000 and interfaces for circuit testing and system evaluation.

Item Description	Source	Part #	Qty.
Telecommunications Fireberd 6000	TTC	MC6000	1
RS449/EIA 530 Interface	TTC	41400	1
T1/FT1 Drop & Insert	TTC	41440A	1
Diphase Interface Card	TTC	42242	1
Cable, Bantam to RJ48 for T1	TTC	CB-41645	1
Cable, RS449/MIL 188 37 pin D male to male 10’	TTC	CB-10417	1
Cable, RS232/EIA530/V.24 male to male 10’	TTC	CB-10418	1

Table 7-14 Laptop Computer Kit 67-P43024D001

Contains Laptop Computer for module configuration and Ethernet Sniffer Software for testing and monitoring the integrity of the network.

Item Description	Source	Part #	Qty.
Laptop Computer-Including backlit displayXircom modem and	Panasonic	17-P50041H001	4
CD ROM (24X)	Panasonic	CF-VCD271	4
FDD/CD-ROM Cable	Panasonic	CF-VCF271	4
Sniffer Portable Analysis Suite	NAI	SBP-DRCT-NA-350-S-1	1
Kit Sub-Assembly	Motorola	15-P42982D004	1

Table 7-15 Large UPS Kit 67-P50026H001

Provides protection and backup (1500VA) of prime power circuits.

Item Description	Source	Part #	Qty.
1500VA UPS	UPSI	1500TR-II	3
UPSI International Power Cord Kit	UPSI	PC-INTL	3

Table 7-16 Small UPS Kit 67-P43025D001

Provides protection and backup (650VA) of prime power circuits.

Item Description	Source	Part #	Qty.
650VA UPS	UPSI	650BRX-TDC	4
Kit Sub-Assembly	Motorola	15-P42982D005	1

Table 7-17 TRI-TAC Interface Kit 67-P50027H001

The TRI-TAC interface kit provides the cards to interface to Legacy TRI-TAC equipment.

Item Description	Source	Part #	Qty.
SF Trunk (2 circuits type 34 and 36)	Redcom	MK0629-114	3
MF Sender/Receiver (8 Ckt)	Redcom	MK0520-102	1

Table 7-18 International Kit 67-P50028H001

The International kit provides the DS1 interface to International PSTN.

Item Description	Source	Part #	Qty.
E1 boardset (30 channel/2 board set)	Redcom	MK0337-002	1
R2 transceiver	Redcom	MK0520-002	1

Table 7-19 Radio Interface Kit 67-P50029H001

The Radio Interface Kit provides the interface for the various (VHF, UHF and HF) Radios and their encryption device.

Item Description	Source	Part #	Qty.
LST-5 Boards	DPI	4520	2
Cable Assembly	Motorola	113499-01	4

Table 7-20 Local Base Interface Kit 67-P50030H001

The Local Base interface Kit provides the interface to the Local Base or Host Nations PSTN.

Item Description	Source	Part #	Qty.
LSRD/GSRD trunk board FX0 Trunk	Redcom	MK0331-101	2
E&M trunk 4 wire board	Redcom	MK0341-106	2

Table 7-21 Subscriber Loop Kit 67-P50031H001

The Subscriber Loop Kit provides additional subscribers and BRI ISDN phone capability.

Item Description	Source	Part #	Qty.
Expanded line circuit card	Redcom	MK0653-103	6
Basic rate interface "U"	Redcom	MA0530-322	1

Table 7-22 T1 Trunk Kit 67-P50032H001

The T1 Trunk Kit provides the Primary Rate Interface Trunk (ISDN PRI) capability from the PBX.

Item Description	Source	Part #	Qty.
DS1 boardset (24 channels/2 board set)	Redcom	MK0292-003	2
MTI (2 ISDN PRI D-channels)	Redcom	MK0463-101	1

Table 7-23 Subscriber Extension Kit 67-P50033H001

The Subscriber Extension Kit provides the Remote Subscriber interface capability to the PBX. This interface uses the Remote Zone connectors to connect remote users into the PBX.

Item Description	Source	Part #	Qty.
Punch down block w/12-4 cond (RJ11) Prewired	NCI	421141	2
Punch down block w/8-4 cond (RJ11) Prewired	NCI	421142	2
12port 2cond (RJ11) to 1-Telco Female	NCI	441108	4
25port 2cond (RJ11) to 2-Telco Bridged (1M&1F)	NCI	441110	2
Telco (50Pin) Female to 12-4 cond (RJ11) Jacks (Harmonica)	NCI	424160	4
25 pair cable - 50 pin telco (Male) one end - one end open (100')	Blackbox	ELN25T-0100-M	2
25 pair cable - 50 pin telco (Male) one end - one end open (200')	Blackbox	ELN25T-0200-M	2
25 pair cable - Male 50 pin telco on both ends (100')	Blackbox	ELN25T-0100-MM	2
25 pair cable - Male 50 pin telco on both ends (200')	Blackbox	ELN25T-0200-MM	2
25 pair cable - Male 50 pin telco on one end - Female on other end (100')	Blackbox	ELN25T-0100-MF	2

Table 7-24 FCC-100 Multiplexer Kit 67-P42988D001

The FCC-100 Multiplexer Kit provides multiplexing capabilities.

Item Description	Source	Part #	Qty.
Dual VF FXS Interface	DNE	21000821	1
CELP / STU-III Compression Applique	DNE	21000933	1
CELP / FAX / Modem Compression Applique	DNE	21000965	1
Asynchronous Digital	DNE	84890210	1
Universal Dual port Carrier	DNE	84890350	1
Synchronous Digital Interface	DNE	84890540	1
Balanced	DNE	84890630	1
Unbalanced	DNE	84890670	1
RS-422 / RS-423 Driver	DNE	85090180	1
Aggregate Carrier	DNE	85970030	1
High Speed TRI-TAC Driver	DNE	85970130-058	1
Low Speed TRI-TAC Driver	DNE	85970130-125	1
FCC-100 16 Channel	DNE	97010109-062	1
DB-25 Extender Board for Ports 1-4	DNE	97090000-001	1
DB-25 Extender Board for Ports 15 & 16	DNE	97090000-002	1
DB-25 Extender Board	DNE	97090000-003	1
DB-25 Extender Board for Front Panel IF	DNE	97090000-004	1
Kit Sub-Assembly	Motorola	15-P42982D026	1

Table 7-25 Tripod Kit 67-P42996D001

The Tripod Kit contains a tripod and a mounting head.

Item Description	Source	Part #	Qty.
Tripod	Nalpak	4-63120-BLKA	1
Head, Pan & Tilt	Nalpak	4-52926-BLK	1
Kit Sub-Assembly	Motorola	15-P42982D017	1

Table 7-26 Remote Frame Kit 67-P43022D001

The Remote Frame Kit provides remote phone connections.

Item Description	Source	Part #	Qty.
Splitter, Unicom RJ-11	Unicom	CMJ-11M	8
Splitter, Unicom 10Base T	Unicom	CMJ-812F-10T	8
Data Cable 50 feet	Blackbox	ELN25T-0050MF	4

Data Cable 100 feet	Blackbox	ELN25T-0100MF	12
RMT Data DISTR FR Cable	AZ Components	AM6174	8
RMT VO DISTR FR Cable	AZ Components	AM6175	8
Kit Sub-Assembly	Motorola	15-P42982D002	1

Table 7-27 Printer Kit 67-P43023D001

The Printer kit contains a Laser Printer, Printer Cable and paper for printing reports.

Item Description	Source	Part #	Qty.
Printer	Lexmark	OPTRAT612N	1
Paper, white generic 8.5" X 11"	Replicopy	35305	2
Cable Assembly	LCOM	TDR855-15	1
Caution Label	Motorola	33-P43213D011	1
Kit Sub-Assembly	Motorola	15-P42982D003	1

Table 7-28 Telephone Kit 67-P43030D001

The Telephone Kit contains generic telephones that are used in the TDC / ICAP System.

Item Description	Source	Part #	Qty.
Telephone	Cortelco	8150CL-V0E-21F	48
Kit Sub-Assembly	Motorola	15-P42982D010	1

Table 7-29 Material Handling Kit 67-P42987D001

The Material Handling Kit contains items used for moving and handling material.

Item Description	Source	Part #	Qty.
Bag, Material Handling Kit	Apache Awning	56-P42986D001	1
Hand-Truck	Nalpak	MAG24SR/STD	1
Carpeted Bed Plate	Nalpak	MAG-BP/SR	1
Nose Plate Heavy Duty Extension	Nalpak	MAG-24EN/EL/HD	1
All Terrain tires	Nalpak	MAG-QUAD11	1
Stair Climber	Nalpak	MAG-24C5	1

Table 7-30 DVST Kit 67-P43021D002

The DSVT Kit provides the capability to connect KY-68 (DSVT) and TA-954 or TA-1024 (DNVT) tactical telephones to the TDC voice switch. The KY-68 card appears to the voice switch as a four-circuit line card.

Item Description	Source	Part #	Qty.
KY-68 Interface Card	Motorola	4568	3
Cable, KY-68 Interface Card	REDCOM	CA9079-A12	6
Kit Sub-Assembly	Motorola	15-P42982D031	1

3.2 INTEGRATION AND INTERFACES

TDC-ICAP modules interface to one another via a relatively small set of common interfaces and cable which provides the installer the flexibility necessary to create an almost unlimited number of network configurations. Each configuration may be viewed as a single entity or network having a set of interfaces for user (subscriber) access and external network interface (Figure 37).

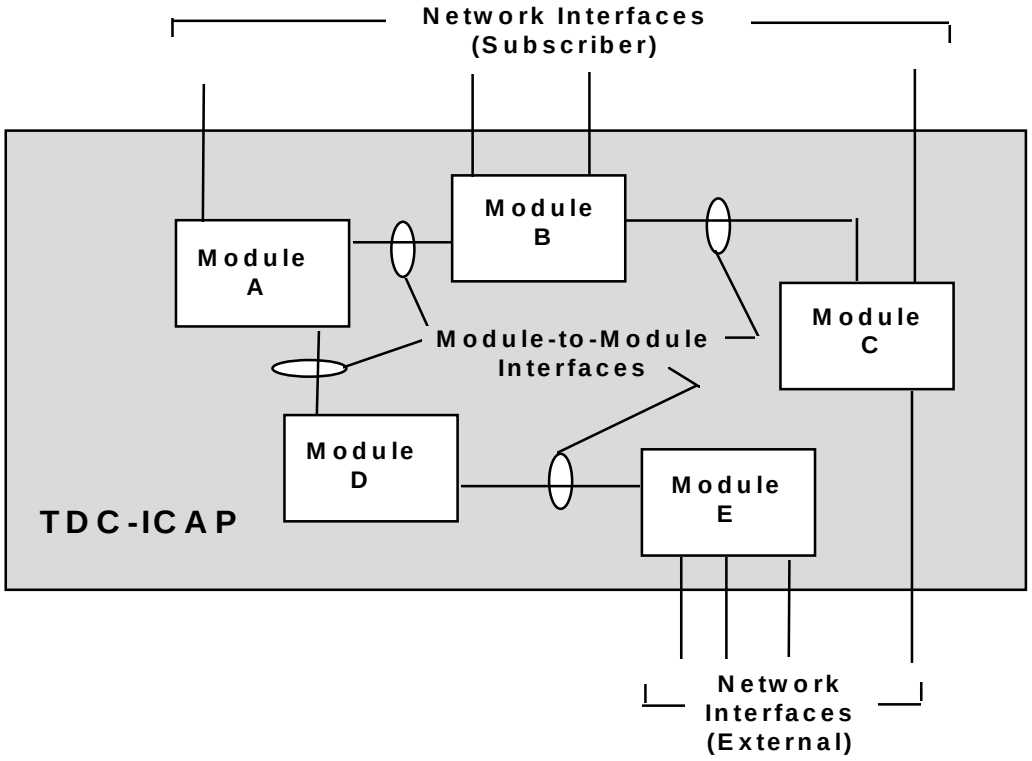


Figure 37: TDC-ICAP Interface Definitions

Each TDC-ICAP network configuration is designed to operate within a hybrid ICAP/TRI-TAC environment that is expected to last for many years to come. As a consequence, module function and external interfaces are designed to interoperate with these legacy networks and systems.

3.2.1 Legacy System Interoperability

3.2.1.1 TRI TAC Loop Interfaces

TDC ICAP provides both analog and digital interfaces to legacy multiplexer equipment and switches at the loop level (Figures 38a, b and c). TRI-TAC multiplex equipment accepts channel side interfaces at either 16 or 32 kbps and all loop interfaces to the same multiplexer or switch must be at the same rate. However, the protocols generated by the Message Terminal Module (CGS-100 Message Switch) are only compatible with the

AN/TYC-39 message switch (on the other end) up to a maximum data rate of 16 kbps. In addition, the maximum rate that can be interfaced to an AUTODIN Switching Center (ASC) is 2.4 kbps. Consequently, special considerations must be given to the message traffic loop interface.

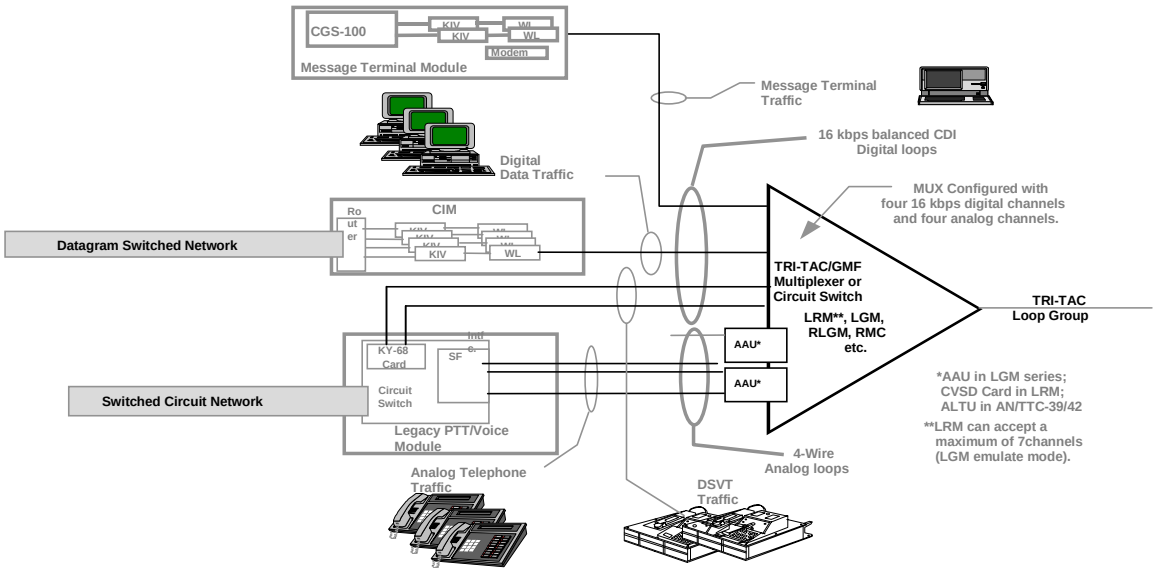


Figure 38a: TDC-ICAP Loop Interfaces (Case 1)

Interface Case 1 (Figure 38a) may be used with either TRI-TAC or GMF terminal systems. AUTODIN message traffic is interfaced directly from a CDI wireline port on the Message Terminal Module to a 16 kbps channel on a loop multiplexer or TRI-TAC switch. Similarly, a pair of 16 kbps DSVT long local loops is interfaced to a digital channel via a DSVT Kit card installed into one of the shelves in the Legacy PTT/Voice Module. In case 1, all channels rates are 16 kbps. Since message traffic is also at 16 kbps, it is not compatible with the ASC.

Digital IP data on the Datagram Switched Network interfaces directly to a multiplexer channel via the Crypto Interface Module. In this configuration, the router in the CIM converts IP datagrams to/from 16 kbps CDI serial channels that interface as digital loops after encryption/decryption with KG 84 compatible crypto devices.

DSN or TRI-TAC circuit switched telephone traffic interfaces as analog trunk channels with analog appliqué unit (AAU), continuously variable slope delta (CVSD) or analog line termination unit (ALTU) cards installed within the multiplexer/switch. Each AAU, CVSD or ALTU card provides two four-wire full-duplex analog channels, which replace two digital channels.

Interface Case 2 (Figure 38b) is the preferred interface with the TRI-TAC LGM family of multiplexers. AUTODIN message traffic at 1.2 kbps or 2.4 kbps is interfaced from the analog subscriber port (modem) on the Message Terminal Module to an analog port of an

AAU or ALTU. The physical interface for voice and digital data to the other channels is the same as in Case 1. However, since ports no longer are required to run at 16 kbps, 32 kbps channels may be used for voice and digital data. In this case, message traffic also occupies a full 32 kbps channel even though it may be only running at 1.2 kbps.

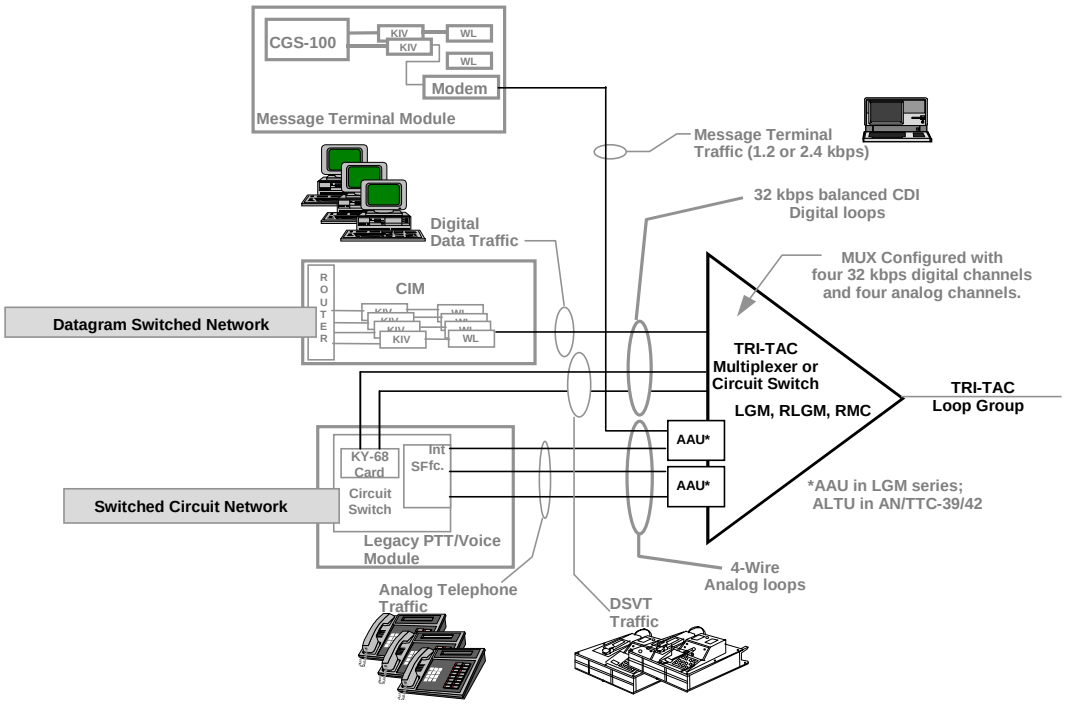


Figure 38b: TDC-ICAP Loop Interfaces (Case 2)

Case 3 (Figure 38c) presents the preferred loop interface to GMF terminals via their low rate multiplexer (LRM). Unlike the LGM multiplexer family, the LRM can accept data at many different rates the only restriction being that the sum of the channel rates plus overhead cannot exceed 256 kbps. Consequently, a wireline port of the Message Terminal Module is interfaced directly to the LGM at 1.2 kbps or 2.4 kbps with the remainder of the channels set to 32 kbps.[†]

[†] The LRM can accept channel rates up to 56 kbps. See Table V-2 of CJSM 6231.04 for a list of compatible data rates.

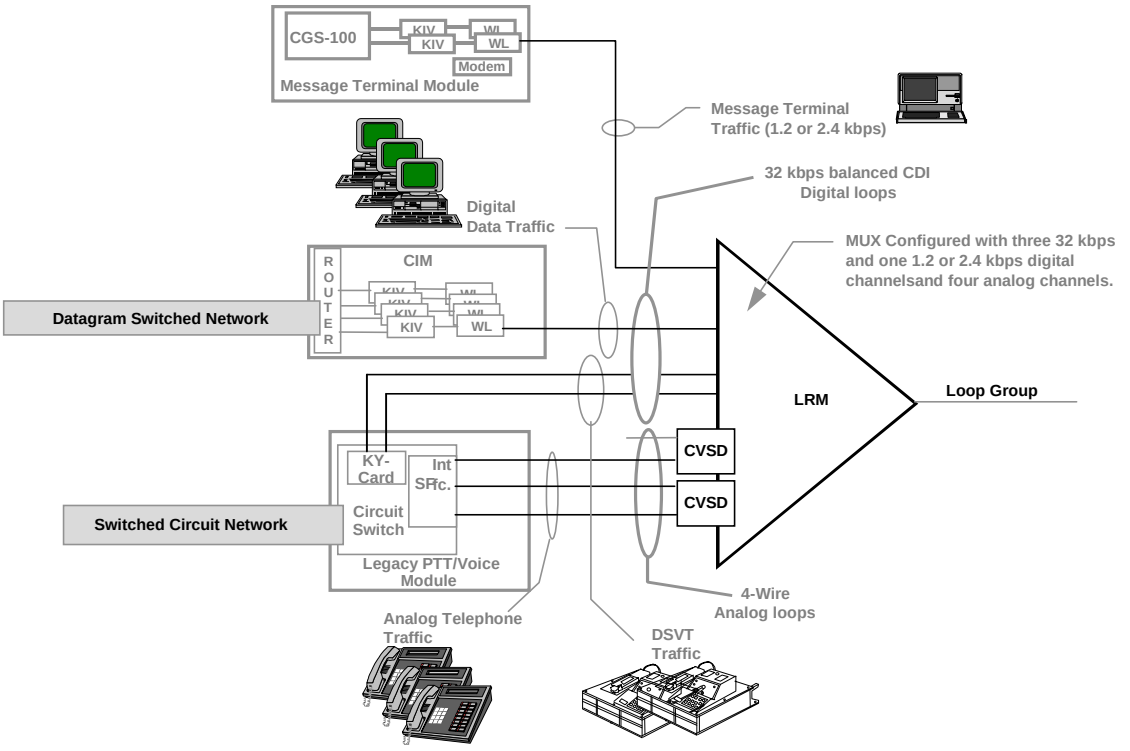


Figure 38c: TDC-ICAP Loop Interfaces (Case 3)

In all cases, physical loop interface connections are made using twisted pair cable assemblies fabricated in the field from "W3" cable and connectors (paragraph 3.1.2.1.1) where applicable.

3.2.1.2 TRI-TAC Group Interfaces

TDC ICAP provides TRI TAC group rate interfaces with the aggregate side of its Promina and AN/FCC-100 multiplexers. (Figure 39). Both unbalanced CDI (CX-11230) and balanced NRZ interfaces are available. NRZ trunks may be configured at both TRI TAC modulo 8 and ATACS modulo 9 rates while CDI trunks are limited to any of the TRI-TAC rates between 128 kbps and 1,024 kbps.

TDC ICAP may be interfaced to group ports 2, 3 and 4 of a TRI TAC Trunk Group Multiplexer (TGM) as shown in Figure 39. Since TDC ICAP trunks are not framed as TRI TAC digital transmission groups, channel 1 of the TGM must be connected to a device such as an LGM (Loop Group Multiplexer) that provides properly framed TRI TAC trunk groups. In addition, the TDC ICAP trunks must be configured at data rates, which are equal to or less than the group 1 rate.

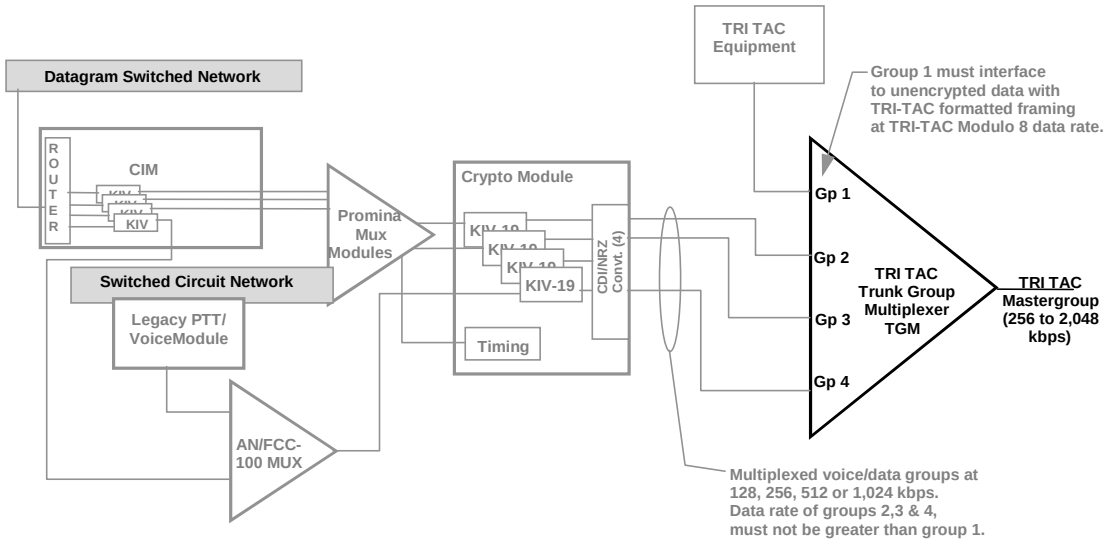


Figure 39: TDC ICAP Interface with a TRI TAC Trunk Group Multiplexer (TGM)

TDC ICAP trunk groups may also be interfaced to the group ports on the TD-1337(V) TSSP (Tactical Satellite Signal Processor) multiplexer used in the GMF (Ground Mobile Forces) satellite terminals. These multiplexers do not require TRI TAC framing and will operate properly with only TDC ICAP trunks. 576 kbps is the highest data rate that a single TSSP group port can accommodate. However, two ports may be strapped together for 1,024 kbps or 1,152 kbps (NRZ only) operation.

3.2.1.3 Interface to Reachback or STEP

Figures 40 and 41 provide a notional interface between TDC ICAP and Reachback or a Standard Tactical Entry Point (STEP) via GMF satellite earth terminals. In these illustrations, the Promina 400 multiplexer contained in the Promina P-Mux Module provides multiplexing and demultiplexing functions. Black digital data from the Datagram Switched Network is routed via KIV 7HS cryptos in the Crypto Interface Module to high-speed serial mux channels. Similarly, red data is encrypted/decrypted by KIV 7HS cryptos in the Red Router Module and routed to Promina serial channels.

Analog DSN trunks and 16/32 kbps loops from message terminals and KY-68 telephones (via the DSVT Kit cards) interface with one of the GMF terminals' low rate multiplexers (LRMs). The LRM's aggregate loop group interfaces to the TSSP via a KG81/94 TED within the GMF Terminal.

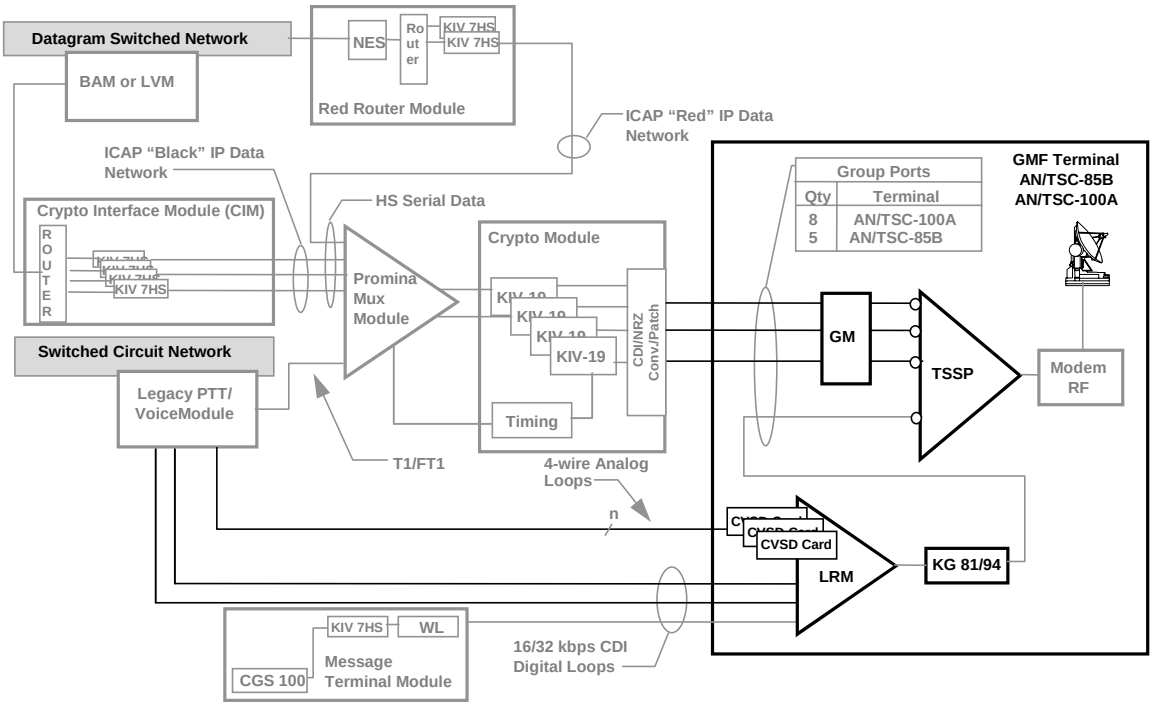


Figure 40: Reachback/STEP Interface of TDC ICAP via AN/TSC-85B or AN/TSC-100A GMF Satellite Terminals

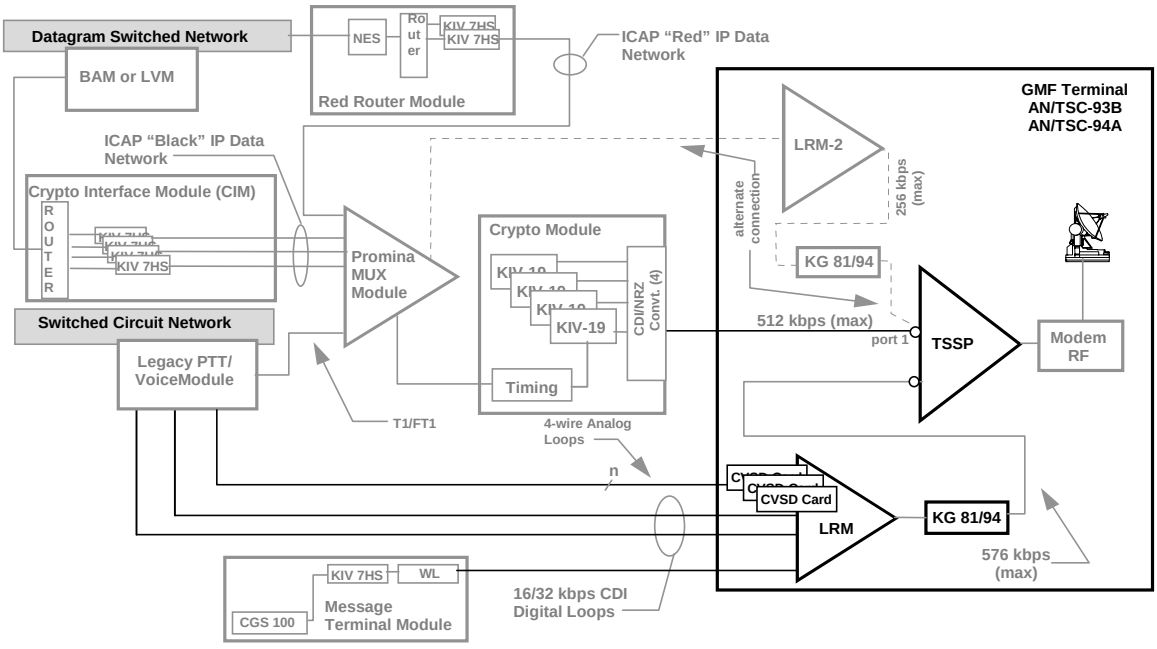


Figure 41: Reachback/STEP Interface of TDC ICAP via AN/TSC-93B or AN/TSC-94A GMF Satellite Terminals

In the AN/TSC-85B/100A illustration of Figure 40, three aggregate Promina trunks are bulk encrypted/decrypted by KIV-19 (KG-194 compatible) trunk encryption devices (TEDs) within the Crypto Module and interfaced to group ports on the TSSP via MD-1026 Group Modems. The AN/TSC-93B/94A terminal's TSSP can accept only two group inputs.

3.2.1.4 Interface to ARFOR and Joint Forces.

Certain Army and Joint Forces use Motorola Network Encryption System (NES) security devices as well as KIV-7HS serial cryptos to encrypt and decrypt black communication channels. This connection permits TDC ICAP black Switched Datagram Network traffic to be communicated through an all red network to another black network located with the *other* or *joint* service unit. Figure 42 diagrams the functional network interconnection with an emphasis on network security. The exact data communication channel will vary depending on the particular service. For example, interconnection with ARFOR will typically be via one or more 16 or 32 kbps TRI-TAC loop interfaces (paragraph 3.2.1.1). Similarly, interconnection to joint forces may be via a Promina multiplexed high-speed (HS) serial data channel similar to the Reachback/STEP connections discussed in the previous paragraph.

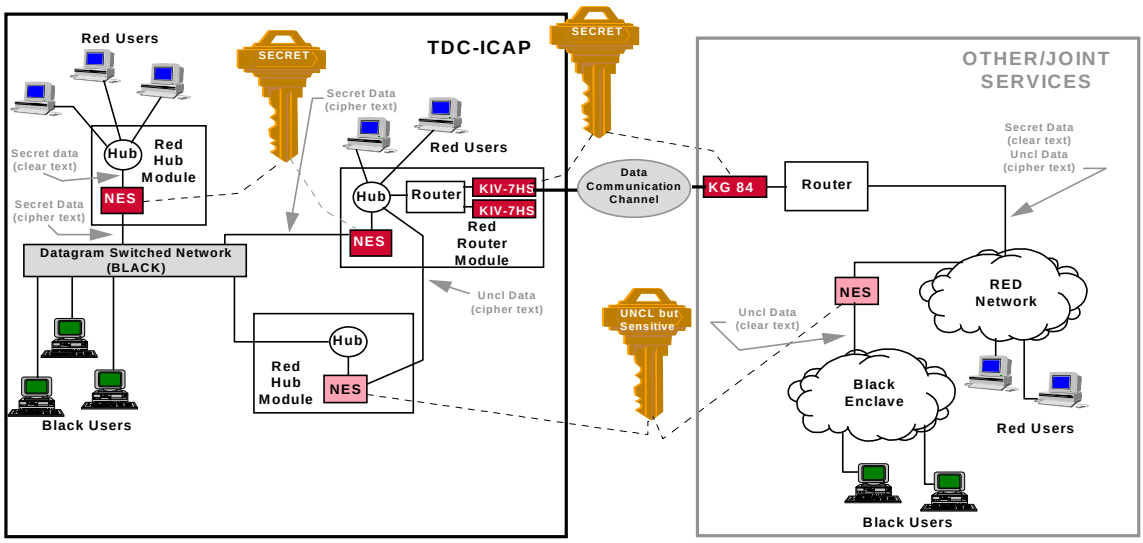


Figure 42: TDC ICAP Interoperability via NES Secured Communication Channels

3.2.1.5 Interface to TASDAC

Figure 43 provides a notional TDC ICAP interface with TASDAC. Red data to be routed to TASDAC is secured with a standalone NES. The encrypted, red data is routed along with black plain text by a Red Router to either a local TASDAC system or to one of TASDAC's remote fixed sites worldwide. Remote communication channels are encrypted with KIV-7HS cryptos in the CIM, which interface to TRI-TAC digital loop channels on loop group multiplex equipment.

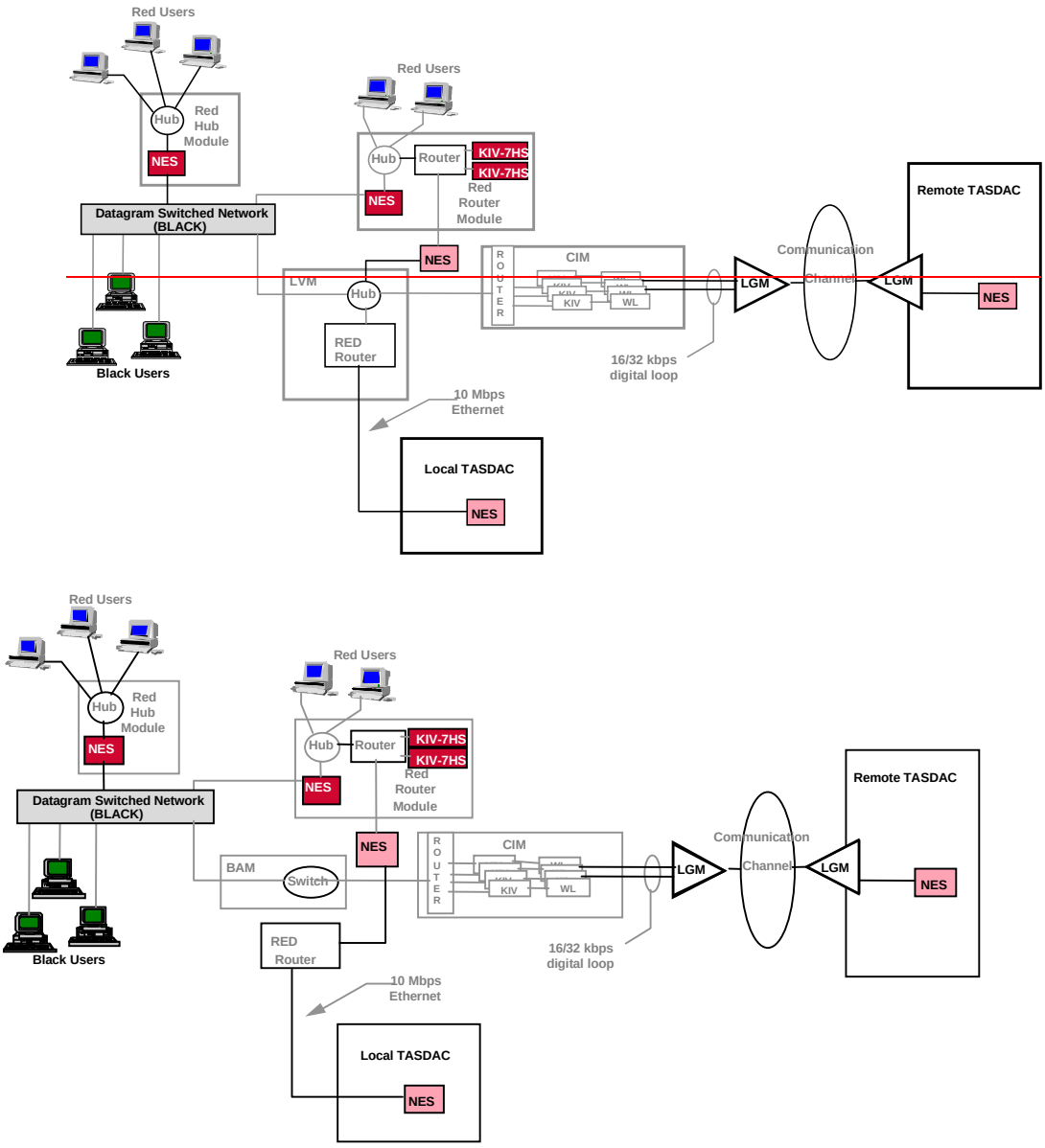


Figure 43: TDC ICAP Interface with TASDAC

3.2.1.6 Interface with TDC ICAP

Two or more TDC ICAP systems may be interconnected over a TRI-TAC communication channel. This interface uses the Promina multiplexers and is similar to the connections with Reachback or STEP.

Figure 44 provides a notional connection of TDC ICAP to an AN/TRC-170 tropospheric scatter terminal for communication to another TDC ICAP system. Observe that channel 1 of the terminal's TGM is connected to an LGM digital trunk group to provide TRI TAC framing. It is important to note that all ICAP connections to the AN/TRC-170 terminal

may not be destined for another ICAP network. For example, the LGM connections will most likely be separated at the remote terminal and interfaced to other TRI-TAC assets.

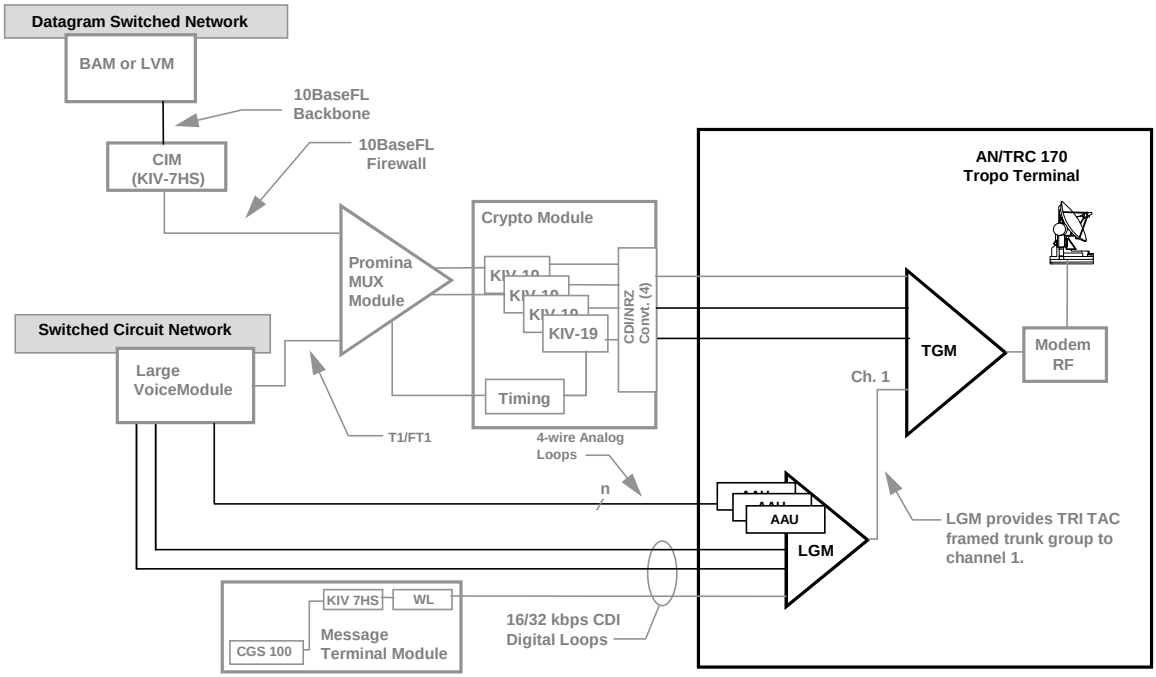


Figure 44: ICAP to ICAP Multiplexed System Interface

3.2.1.7 System Timing

When TDC ICAP communicates synchronous serial data to external systems that perform time domain multiplexing (TDM) (or are connected to other TDM systems downstream), the timing of the serial data becomes of critical importance. That is, the frequency and relative phase of the clock signal of all multiplexed channels must be essentially the same to permit each channel to be placed into a time slot that is fixed with respect to the other channels. For example, two synchronous channels with a one-Hertz relative clock error will result in a relative slip of one-bit time per second.

For most interfaces, TDC ICAP employs an independent clock approach. That is, TDC ICAP references its external timing to the highly accurate and stable (stratum 1) primary reference source (PRS) located in the Crypto Module and relies on the fact that other TDM systems downstream are similarly timed.

Figure 45 illustrates how TDC ICAP's multiplexed external plain text (PT) and cipher text (CT) transmit (TX) timing is referenced to the Crypto Module's PRS. In addition, it shows how the switched circuit network also derives its timing from the PRS. It is important to note that the ICAP circuit switch (or one of the circuit switches) that connects directly to the Promina MUX DS-1 port must be set to reference its timing to

this channel. This switch then becomes the master timing reference for the remaining circuit switches connected to the SCN.

The multiplexed trunks will generally interface to either a legacy TGM or a TSSP as described in paragraph 3.2.1.2. The TGM cannot derive its timing from TDC ICAP. Instead, it must derive it timing from an external reference source locally or by locking to the received supergroup (loopback). If operated in the loopback mode, the remote multiplexer must be timed from an external reference. In either case, the TGM external reference should be stratum 2 or better. The TSSP is able to derive its timing from the TDC ICAP TX trunk and take advantage of the stratum 1 PRS. When TDC ICAP timing stability is desired, the reference ICAP CDI trunk should be connected to TSSP port 1. The TSSP has to be programmed to use the "external standard" mode to derive timing.

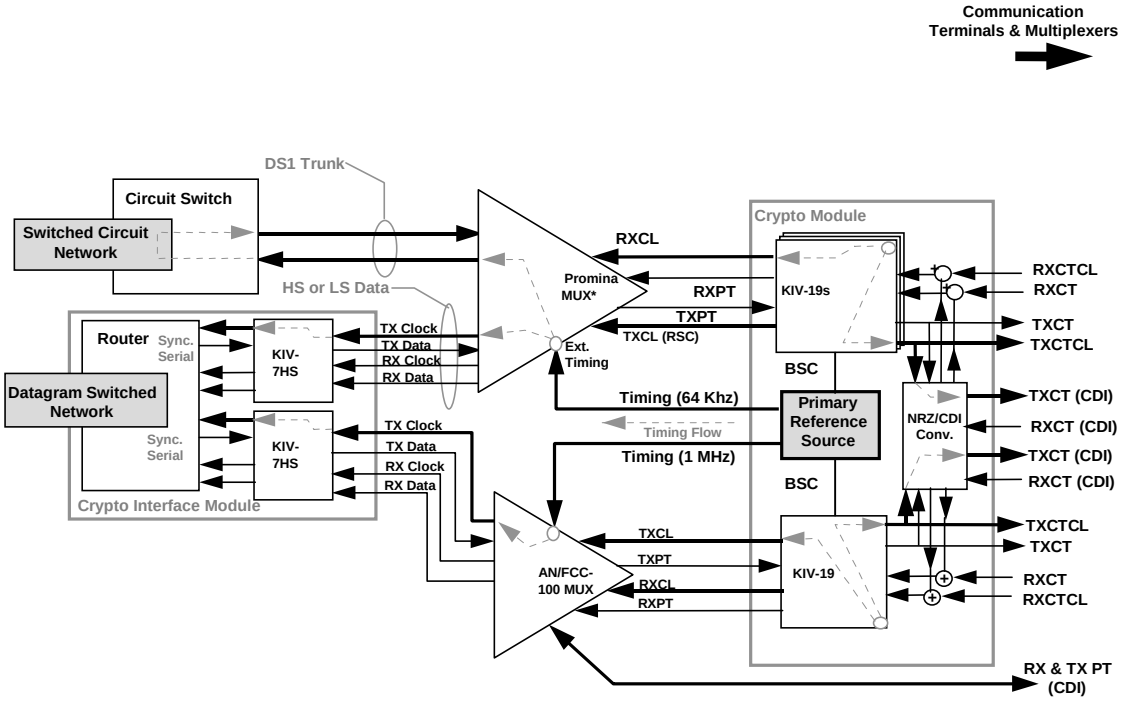


Figure 45: Timing of TDC ICAP Multiplexed Communication

Figure 46 illustrates how TDC ICAP interfaces at the loop level to legacy multiplexer or circuit channels. The KY-68 long-local loops derive their timing from the SCN, which is referenced to TDC ICAP's stratum 1 PRS as described earlier. However, when either the Crypto Interface or Message Terminal Modules' high speed wireline adapter is connected directly to a channel on a legacy multiplexer or switch, the timing reference is derived from the external channel.

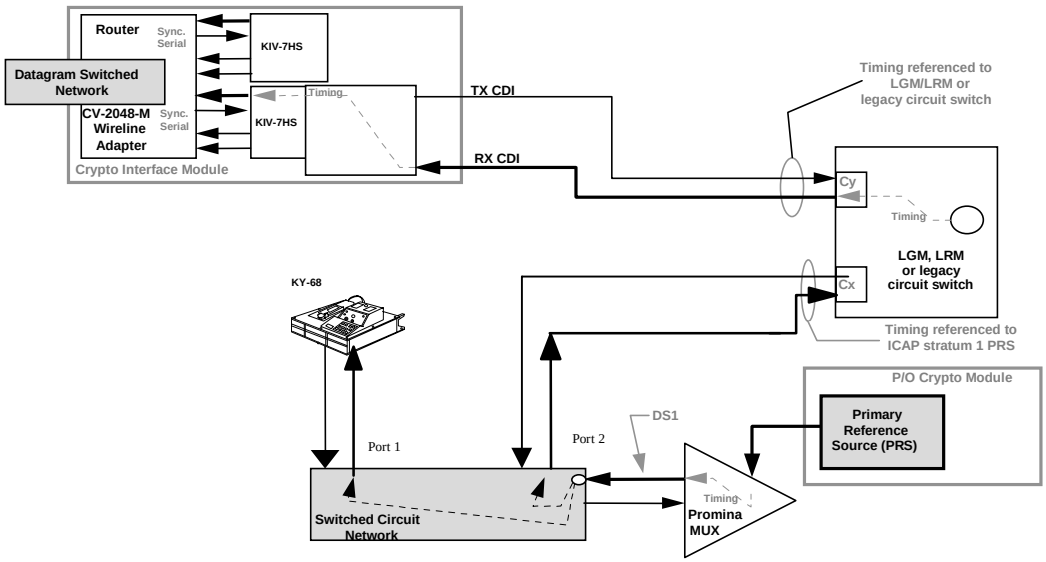


Figure 46: Timing of 32/64 kbps Channel Level Interfaces

A final example of TDC ICAP interface timing is illustrated in Figure 47. In this diagram, a pair of Crypto Interface Modules is used to establish a secure connection between ICAP and another network via wireline. The high speed (HS) wireline adapter in the CIM has its own synthesized clock generator which may be adjusted to provide clock rates between 1200 Hz and 2048 kHz (the KIV-7HS is limited to 1.544 Mbps). Since this is a point-to-point connection with no multiplexing, timing stability is not highly critical. Consequently, the internal wireline adapter's clock synthesizer is adequate.

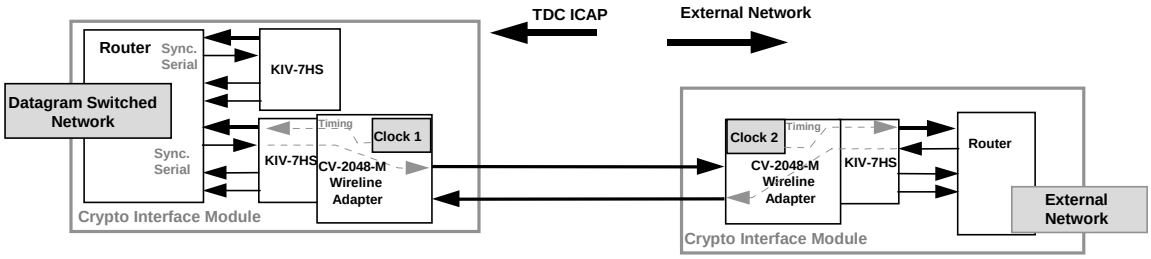


Figure 47: Interconnection of ICAP to an External Network via Wireline

3.2.1.8 Echo Cancellation

Since the analog telephones in TDC ICAP are 2-wire, the party on the other end of a "long-distance call" will hear an echo of his speech if echo cancellation is not in place on the TDC ICAP end of the channel. TDC ICAP includes digital echo cancelers in the Promina 400 within Promina P-MUX Module as well as stand alone versions in the echo cancellation kit. These echo cancelers continuously estimate the received voice vector that is reflected by the ICAP SCN into the transmit voice path and subtract this estimate from the transmitted voice signal. Figure 48 illustrates how the Promina echo cancellation function may be used on TRI-TAC and GMF voice channels that interface directly to

analog line termination units (LTUs) in TRI-TAC/GMF multiplexers and switches. In this example, the SCN is interfaced to the Promina multiplexer with two T-1 interfaces. Long-distance voice channels destined for direct LTU connection are established through internal channel routing within the Promina 400 with echo cancellation enabled on ICAP subscriber side of the using the Promina echo cancellation features.

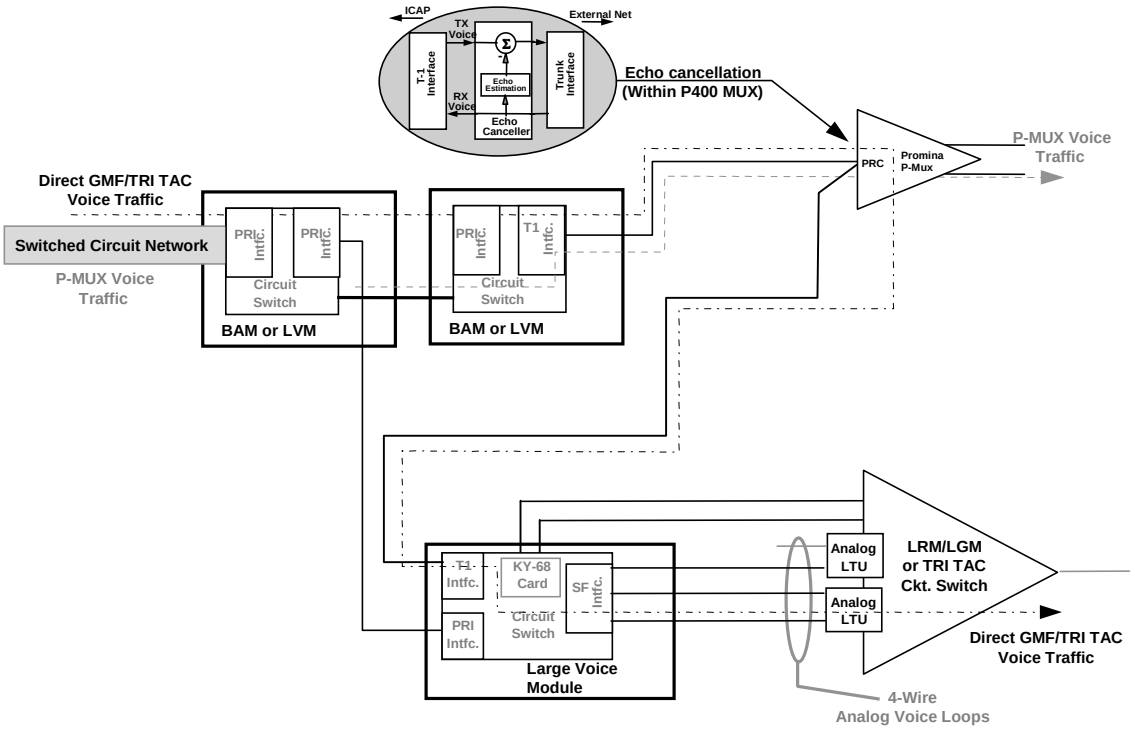


Figure 48: ECHO Cancellation of Direct TRI-TAC/GMF Voice Channels

3.2.2 Module-to-Module Interfaces

Module interfaces shall conform to the interface requirements provided in their respective Module Requirement Documents. Table 11 provides a summary of all module to module interfaces.

Table 11: Module-to-Module Interfaces

Interface Name	Applicable Modules and Components	Function	Con-nector Type	Characteristics
DS1 Backbone	• Basic Access • Large Voice (Legacy PTT/Voice) • RF Module • Laser • TSSR Interface Unit • Promina P-MUX Module	Interconnect to establish switched circuit network (SCN).	ST (2)	DS-1 / ISDN PRI (1.544 MBPS) modulated onto proprietary multi-mode fiber optic carrier.
10BaseFL/ 100BaseFX Backbone	• Basic Access • Red Hub • Red Router • RF Module • Laser • TSSR Interface Unit • NMT-P • CIM	Interconnect to establish datagram switching network.	ST (2)	10BaseFL/100BaseFX (IEEE 802.3J SUPP), Ethernet. (multi-mode fiber optic cable)
10 / 100 BaseFL Firewall	• NMT-P (Firewall) • CIM	Interconnect between the Firewall Module's external network port and the Crypto Interface Module.	ST	10BaseFL (IEEE 802.3J SUPP), Ethernet. (multi-mode fiber optic cable)
Ethernet 10BaseT/100BaseTX (network)	• NMT-P • NMT-U • Basic Access • Red Hub • Red Router • Message Terminal	Network interconnect for red NMT to Red Hub or Red Router. Network interconnect for black NMT and Panavue modules to LVM. Network interconnect for firewall and server (NMT-P) modules to LVM.	RJ-45 Pin 1: T1 Pin 2: R1 Pin 3: T2 Pin 6: R2	10BaseT/100BaseTX, Ethernet. (IEEE 802.3)
Analog Sub-scriber	• Basic Access • Large Voice (Legacy PTT/Voice) • NMT-P	Interconnect circuit switch to STU IIIR Module. Interconnect CSMT to LVM.	RJ-11	2-wire analog subscriber lines with loop start and DTMF or pulse signaling.

Table 11 Cont'd: Module-to-Module Interfaces

Interface Name	Applicable Modules and Components	Function	Con-nector Type	Characteristics
Switch Bus	• Basic Access • Large Voice (Legacy PTT/Voice)	Used to interconnect two circuit switches.	Vendor specific	Vendor proprietary.
ISDN BRI	• Basic Access with optional LRUs • Large Voice (Legacy PTT/Voice) • ISDN Terminal Adapters • Message Terminal	Used to interconnect circuit switch to ISDN Terminal Adapter used for a point-to-point digital data connection.	TA's RJ-45 (Pins 4 & 5) Modules RJ-11 (Pins 3 & 4)	ISDN "U" Interface; 2-wire 2B1Q; IAW ITU Q.921; Q.931 and I.430.
EIA-232 Serial	• ISDN Terminal Adapter • Message Terminal Module • Promina P-MUX Module • ~~CIM~~RHM • RRM • Crypto Module • ~~BAM~~ • LVM	Connects ISDN TA , Message Terminal and CIM to low speed (LS) serial channel of Promina multiplexer. Used for administration connections to muxes and circuit switches. ~~Connects time of day clock between Crypto Module and LVM or BAM.~~	DB-25 or DB-9	EIA-232C Table 12
EIA-422 Serial	• AN/FCC-100 • Promina P-MUX Module • CIM	Used to connect CIM data channels to high speed (HS) serial channel of Promina multiplexer and AN/FCC-100.	DB-25	EIA-530 Table 13
FXS/FXO Trunk	• AN/FCC-100 • Large Voice (Legacy/PTT Voice)	Used to connect FXS/FXO channel between AN/FCC-100 and PTT/Legacy Voice Module.	FCC-100 DB-25 (Pins 2 [R] & 14 [T]) LVM(Legacy) RJ-11 (Pins 3 & 4)	LSRD/GSRD Trunk
E&M Trunk	• AN/FCC-100 • PTT/Legacy Voice	Used to connect E&M trunk between AN/FCC-100 and PTT/Legacy Voice Module.	FCC-100 DB-25 (Pins 2 [R] & 14 [T]) LVMLegacy RJ-11s (4)	4-Wire; Type II E&M Table 14
Promina Trunk	• Promina P-MUX Module	Connects multiple Promina multiplexers together for additional capacity.	DB-25	EIA-530 Table 13

Table 11 Cont'd. Module-to-Module Interfaces

Interface Name	Applicable Modules and Components	Function	Connector Type	Characteristics
Red I/O NRZ	• Promina P-MUX Module • Crypto Module • AN/FCC-100	Connects plain text data between multiplexers and Crypto Module.	DB-25	TIA/EIA-422/423 signal levels Table 15
Timing	• Crypto Module • Promina P-MUX Module • AN/FCC-100	Provides external terminal timing from the Crypto Module to the Promina MUX Module and the AN/FCC-100.	DB25	64 kHz and 1 MHz clocks; TIA/EIA 422-B
Black Station Clock	• Crypto Module • AN/FCC-100	Provide aggregate rate clocks from the AN/FCC-100multiplexers to the KIV-19 TEDs in the Crypto Module.	DB-25	TIA/EIA-422-B

Table 12: EIA-232 Interface

DB-25 Pin	DB-9 Pin	EIA-232C Circuit	Signal
1		AA	Shield
2	3	BA	Transmit Data (to DCE)
3	2	BB	Received Data (from DCE)
4	7	CA	Request to Send (to DCE)
5	8	CB	Clear to Send (from DCE)
6	6	CC	Data Set Ready (from DCE)
7	5	AB	Signal Ground
8		CF	Received line signal detector (from DCE)
9-14			Un-assigned
15		DB	Transmit Clock (from DCE)
16			Un-assigned
17		DD	Receive Clock (from DCE)
18,19			Un-assigned
20	4	CD	Data Terminal Ready (to DCE)
21			Unassigned
22		CE	Ring Indicator (from DCE)
23,24			Unassigned
25		TM	Transmit Clock (to DCE)

Table 13: EIA-530 Interface

DB-25 Pin	EIA Circuit	EIA Type	EIA-530 Signal Name	Promina Trunk Signal Name
1			Shield	Shield
2	BA	422	Transmit Data (+)	Transmit Data (+)
3	BB	422	Receive Data (+)	Receive Data (+)
4	CA	422	Request to Send (+)	Request to Send (+)
5	CB	422	Clear to Send (+)	Clear to Send (+)
6	CC	422	DCE Ready (+)	DCE Ready (+)
7			Signal Ground	Signal Ground
8	CF	422	Received Line Signal Detector (+)	Received Line Signal Detector (+)
9	DD	422	Receive Clock (-)	Receive Clock (-)
10	CF	422	Received Line Signal Detector (-)	Received Line Signal Detector (-)
11	DA	422	Transmit Clock (-) (to DCE)	Terminal Timing (-) (to DCE)
12			Transmit Clock (-) (from DCE)	Transmit Clock (-) (from DCE)
13	CB	422	Clear to Send (-)	Clear to Send (-)
14	BA	422	Transmit Data (-)	Transmit Data (-)
15	DB	422	Transmit Clock (+) (from DCE)	Transmit Clock (+) (from DCE)
16	BB	422	Receive Data (-)	Receive Data (-)
17	DD	422	Receive Clock (+)	Receive Clock (+)
18	LL	423	Local Loopback	Not Assigned
19	CA	422	Request to Send (-)	Request to Send (-)
20	CD	422	DTE Ready (+)	DTE Ready (+)
21	RL	423	Remote Loopback	Not Assigned
22	CC	422	DCE Ready (-)	DCE Ready (-)
23	CD	422	DTE Ready (-)	DTE Ready (-)
24	DA	422	Transmit Clock (+) (to DCE)	Terminal Timing (+) (to DCE)
25	TM	423	Test Mode	Not Assigned

Table 14: Legacy PTT/Voice Module to AN/FCC-100 E&M Interface

AN/FCC-100 DB-25 Pins	Legacy PTT/Voice Module RJ-11 Pins A	B	C	D	Signal
1,18,19,24, 25*	1	1	1	1	Ground
2	3				R
3	4				R1
4			3		SG
5		3			SB
14				3	T
15				4	T1
16			4		E
17		4			M
*Connect together in mating connector					

Table 15: Red I/O NRZ

DB-25 Pin	AN/FCC-100 Signal	EIA Type	MUX Module Signal	EIA Type
1	Shield		Shield	
2	Transmit Data (+)	422	Transmit Data (+)	422
3	Receive Data (+)	422	Receive Data (+)	422
4	Request to Send (+)	422	Crypto Sync (-)	422
5	Not Assigned			
6	DCE Ready (+)	422		
7	Signal Ground		Signal Ground	422
8	Not Assigned			
9	External Clock (+) (Not Used)	422	Receive Clock (-)	422
10	External Clock (-) (Not Used)	422		
11	Crypto Sync (+)	422	Terminal Timing (-) (to DCE)	422
12	Not Used		Transmit Clock (-) (from DCE)	422
13	Not Used			
14	Transmit Data (-)	422	Transmit Data (-)	422
15	Transmit Clock (+) (from DCE)	422	Transmit Clock (+) (from DCE)	422
16	Transmit Clock (-) (from DCE)	422	Receive Data (-)	422
17	Receive Clock (+)	422	Receive Clock (+)	422
18	Receive Clock (-)	422		
19	Receive Data (-)	422	Crypto Sync (+)	422
20	DTE Ready	423		
21	Not Assigned			
22	Not Assigned			
23	Transmit Clock (-) (to DCE)	422		
24	Transmit Clock (+) (to DCE)	422	Terminal Timing (+) (to DCE)	422
25	Crypto Sync (-)	422		

3.2.3 Network Interfaces

The ICAP network shall be configurable to provide the external user and network interfaces shown in the architectural context diagram of Figure 49. Signal inputs are shown on the left and outputs on the right. External entities that both send and receive data from the ICAP are shown on both sides of the diagram. Interface types and their characteristics shall conform to the TDC ICAP Interface Control Document (ICD). Electrical input and output interfaces are summarized in Table 16.

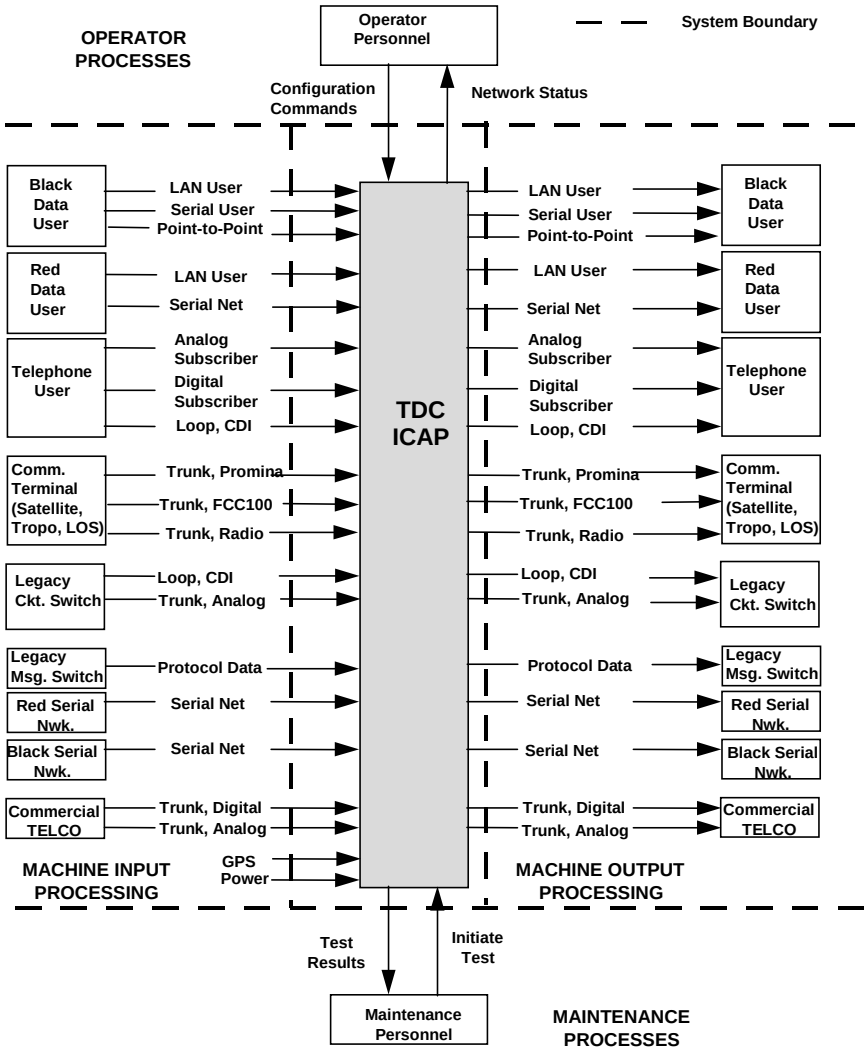


Figure 49: TDC ICAP architectural context diagram showing all external inputs and outputs.

Table 16: TDC ICAP, External Interfaces

Interfacing Entity	Interface Group	Module(s)	Interface	Characteristics
Black Data User	LAN Users	• BAM • LVM	Ethernet Ports	10BaseT/100BaseTX connection via RJ-45 to ICAP black data network.
	Serial Users	• BAM • LVM	Serial IP Data Ports	Sync & Async IP over X.25; EIA-232; connects to ICAP black data network.
			Serial PPP Data Ports	Sync & Async Point-to-Point Protocol (PPP); EIA-232; connects to ICAP black data network.
	Point to Point	• ISDN Terminal Adapters	EIA-232; V.35	Dial-up connection between two ICAP subscribers using ISDN terminal adapter at each end (up to 128 kbps).
Red Data User	LAN Users	• Red Router • Red Hub	Ethernet Ports	10BaseT connection via RJ-45 to ICAP black red network.
	Serial Users		Serial IP Data Ports	Sync & Async IP over X.25; EIA-232; connects to ICAP red data network.
			Serial PPP Data Ports	Sync & Async Point-to-Point Protocol (PPP); EIA-232; connects to ICAP red data network.
Telephone User	Analog Subscriber	• BAM • LVM (Legacy PTT/Voice)	RJ-11 Ports	2-wire analog subscriber lines with loop start and DTMF or pulse signaling. Supports WECO 2500 telephones and compatible products such as modems, Faxes and STU IIIs.
	Digital Subscriber		ISDN	ISDN BRI connections (2B1Q U-Interface). Supports ISDN telephones and video teleconferencing equipment.
	CDI Loop	• DSVT Kit	Balanced CDI (KY-68)	4-wire conditioned di-phase connection including phantom power. Connects via long-local loops to external TRI-TAC circuit switch.
Communication Terminal	Trunk, Promina (Red I/O when un-secure)	• Promina P-MUX • Crypto	NRZ DataTX Data, CDI	Promina non-return to zero interface with terminal; EIA-422.Conditioned di-phase aggregate voice/data channels to terminal; Promina format.
	Trunk, FCC100 (Red I/O when un-secure)	• AN/FCC-100 • Crypto	TX Data, CDI	Conditioned di-phase aggregate voice/data channels to terminal; AN/FCC-100 format.
			RX Data, CDI	Conditioned di-phase aggregate voice/data channels from terminal; AN/FCC-100 format.
			NRZ Data	Alternate AN/FCC-100 non-return to zero interface with terminal; EIA-422.

Table 16 Cont'd. : TDC ICAP, External Interfaces

Interfacing Entity	Interface Group	Module(s)	Interface	Characteristics
Communication Terminal	PTT Radio	• LVM(Legacy PTT/Voice)	Analog Transmit	Transmit audio: 5 to 6 mV RMS into 150 ohm load.
			Analog Receive	Receive audio: 1 Volt RMS (nominal); 600 Ohms.
			PTT	Ground on transmit; open on receive
			Plain Text/ Cipher Text	Crypto status (secure/non-secure) PT = 0 ± .5V; CT = 6.75V +0.5/-1V.
Promina P-MUX Data User	High Speed (HS) Serial	• Promina Mux	EIA-530	High speed serial data connection (up to 1344 kbps) multiplexed to Promina aggregate trunks.
	Low Speed (LS) Serial		EIA-232	Low speed serial data connection (up to 64 kbps) multiplexed to Promina aggregate trunks.
Legacy Circuit Switch & Muxes	CDI Loop	• DSVT KIT • CIM • Message Terminal	Balanced CDI	4-wire conditioned di-phase connection. Interfaces to AN/TTC-39; AN/TTC-42; and SB-3865.
	Legacy Analog Trunks	• LVM(Legacy PTT/Voice)	4-wire SF & LSRD/GSRD trunks	Type 26, 31, 34, 36, 44 & 48 TRI TAC analog trunks programmable by operator.
Legacy Message Switch	Protocol Data	• Message Terminal	Balanced CDI	4-wire conditioned di-phase connection to AN/TYC-39.
Red Serial Network	External Net (serial)	• Red Router	Serial IP Data Ports	IP over X.25 or PPP; EIA-530; bridges external network with serial connection to ICAP red data network.
	External Net (Ethernet)		Ethernet Ports	10BaseT connection via RJ-45
Black Serial Network	Serial Data (routed)	•	Serial IP Data Ports	IP over X.25 or PPP; EIA-530; bridges external network with serial connection to ICAP black data network.
Commercial TELCO	Trunk, Digital	• LVM(Legacy PTT/Voice)	E-1 trunks	2.048 Mbps CEPT 1 per ITU recommendation G.703, 704, 705 and 706. E&M (R1), R2 or pulse signaling.
			T-1 trunks	1.544 Mbps SF or ESF; E&M (R1) or FX signaling; AMI or B8ZS line code.
			ISDN PRI	1.544 Mbps SF or ESF; B8ZS line code; compatible with AT&T 4ESS & 5ESS.
	Trunk, Analog		FXO trunks	600 ohm LSRD/GSRD trunk
GPS	GPS	• Crypto		RF input from GPS satellites used for primary reference timing.
Prime Power Source	Power	All		120/240 VAC; 50 to 60 Hz; single phase prime power.

3.3 FUNCTIONAL REQUIREMENTS

3.3.1 Switched Circuit Network

3.3.1.1 Network Subscribers

The switched circuit network (SCN) shall be capable of providing analog subscriber connections for WECO 2500 compatible devices; e.g., plain old telephones (POTS), facsimile equipment, STU III telephones and personal computer modems. In addition, digital subscriber connections are provided for ISDN Basic rate interface (BRI) compatible devices; e.g., digital telephones, video teleconferencing equipment and ISDN terminal adapters.

3.3.1.2 Circuit Switches

The SCN shall utilize digital 64 kbps pulse code modulation (PCM) circuit switches to provide the following functionality to network subscribers:

a. The size (number of subscribers supported) of the circuit switch network shall be scaleable through the stacking of circuit switches.
b. Circuit (telephone) numbers shall be field programmable to the current Air Force/Joint numbering plan approved for tactical use.
c. The circuit switch function shall provide multi-level precedence and preemption (MLPP).
d. The circuit switch shall permit simultaneous conferences with up to 16 participants per conference. The number of simultaneous conferences shall be scaleable in accordance with the size of the network.
e. The circuit switch shall permit “hot lines” to be established between network connected WECO 2500 type subscriber telephones. That is, the called telephone rings when the calling telephone goes “off-hook”.
f. The circuit switch shall support call forwarding, call pickup, call park, call transfer, preprogrammed, meet-me and three way conference, class-of-service restriction, compressed dialing and station hunting.

3.3.1.3 Network Bandwidth

The SCN shall provide ISDN primary rate interface (PRI) trunk connectivity between circuit switches.

3.3.1.4 DSN Operation

The SCN shall be capable of operating as an extension of the Defense Switched Network (DSN). That is, subscribers connected to the ICAP SCN can make and receive calls to/from the DoD DSN. The Automatic Voice Network (AUTOVON) MLPP function shall be maintained throughout the entire ICAP SCN.

3.3.1.5 Secure Conferencing
The SCN shall be capable of providing a facility to permit secure telephonic conference calls between up to 16 equipped subscribers.

3.3.1.6 External DoD Network Interface
The SCN shall be capable of providing multiple NxDS0 (fractional T-1 format) trunks for direct connection to DoD and/or commercial telephone networks. These trunks will be multiplexed with data channels and communicated to reachback and/or standardized tactical entry point (STEP) facilities where they will be interfaced to the proper DoD/commercial network (Figure 50).

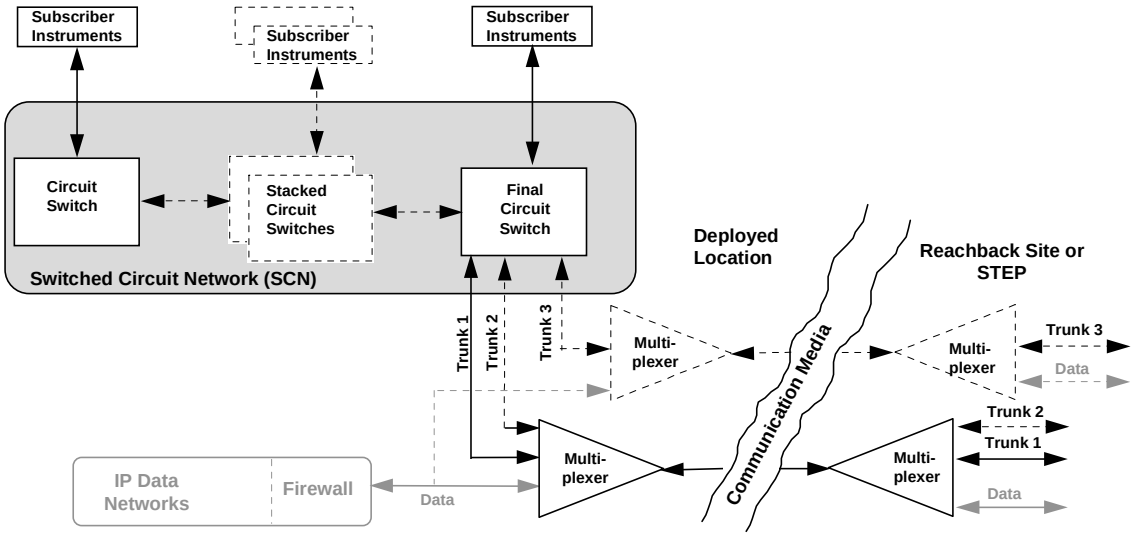


Figure 50: Switched Circuit Network Interface to External DoD and Commercial Networks

3.3.1.7 External Telephone Company (TELCO) Network Interface
The SCN shall be capable of providing external trunks to interface with commercial TELCO systems worldwide with specific characteristics as follows:

a. The specific interface shall be programmable by an installer in the field using specialized circuit switch line replaceable units and/or configuration commands.
b. TELCO interfaces shall be as detailed in paragraph 3.2.2.

3.3.1.8 Secure Push-to-Talk (PTT) Radio
The SCN shall be capable of providing an external system interface to a half-duplex push-to-talk radio such as the LST-5 or EMUT UHF SATCOM terminals with the following features:

a. The interface shall allow an installer to adjust transmit audio levels to match the radio interface.

b. PTT keying shall be voice level activated.
c. The SCN shall allow operation with and without KY-57 or similar type encryptors on the radio's receive/transmit audio interface.

3.3.2 Datagram Switching Networks

TDC ICAP provides both red and black datagram switching networks which are accessible to users at any node or at the network hub**.**

3.3.2.1 Internet Protocol
Both red and black datagram switching networks shall provide an Internet environment to support communication of Internet protocol (IP) datagrams between subscribers.

3.3.2.2 Network Services
Both red and black networks shall provide independent E-mail, file transfer, remote log-in and domain name services.

3.3.2.2.1 Uninterruptable Power Supplies
The computers controlling network services shall be backed up with uninterruptible power supplies to prevent data loss in case of power failure.

3.3.2.3 Network Segmentation
Both red and black networks may be segmented into independent local area networks (LANs) at each user node. Datagrams addressed to local users shall remain on the LAN within the node.

3.3.2.4 Network Backbone
Red and Black networks communicate node-to-node and node-to-hub via an unclassified black network backbone (metropolitan area network). Red/black separation shall be accomplished using an NSA approved network encryption system (NES).

3.3.2.5 External Network Connectivity
TDC ICAP shall include a firewall between the Datagram Switched Network's metropolitan area backbone and external wide area network (WAN) interconnections. A primary purpose of the firewall is to prevent unauthorized WAN subscribers from gaining access to and interacting with TDC ICAP's Switched Datagram Network.

3.3.3 ICAP Network Interconnection

3.3.3.1 Metropolitan Area Network
Node-to-node and node-to-hub (internode) network connections may be accomplished using wired or wireless media.

3.3.3.1.1 Wired Connections
The standard wired internode interface shall be multi-mode fiber optic cable.

a. One fibers connection shall be used for the Switched Circuit Network.
b. The second fiber connection shall be used for the Datagram Switching Network.
c. Internode wired connections shall maintain 1.544 Mbps ISDN PRI and 10 Mbps or 100 Mbps Ethernet transmission rates for switched circuit and datagram switched networks respectively.

3.3.3.1.2 Wireless Connections
The ICAP shall provide radio frequency and laser LOS communication links to enable an operator to establish internode network connections.

a. LOS communication links shall meet the requirements of Table 17.
b. The electrical (optical) channel interface to either wireless LOS link shall be identical to the standard wired internode interface. That is, an installer may use the same cable/connector to interconnect nodes or interconnect a node to a LOS link..
c. The RF LOS link shall include a dedicated IP router function to act as a buffer between the Ethernet rates on the Switched Datagram Network and one or more of the serial communication channels supported by the radio.

Table 17: ICAP Inter-node Wireless LOS Communication Link Parameters

Characteristics	RF LOS Link	Laser LOS Link
Range (clear air)	5 km	1.2 km
Fade Margin (at specified range)	30 dB (min)	17 dB (min)
Frequency	Fixed channels within the 14.4 GHz to 15.35 GHz band.	Not applicable
Data bandwidth	4 independent channels (minimum) that support a 1.544 Mbps (minimum) transmission rate each.	One channel that supports a 1.544 Mbps (minimum) transmission rate. One channel that maintains full 10 Mbps Ethernet connectivity

3.3.3.2 Multiplexed Wide Area Networks
The ICAP shall be capable of time division multiplexing/demultiplexing its Switched Circuit Network and Datagram Switched Network into/from serial aggregate data channels which will interface to DoD wide area networks and deployed equipment via legacy and LMST communication equipment.

3.3.3.2.1 Compatibility
The ICAP shall be capable of interoperating with legacy voice and data networks and deployed equipment via independent aggregate channels conforming to AN/FCC-100 and Promina 400 multiplexer (P-MUX) or Integrated Digital Network Exchange (IDNX) protocols and formats.

3.3.3.2.2 Serial Data Channels
The multiplexer function shall include port side serial data channels that may selected by the operator for dedicated point-to-point serial data communication. These channels are typically used for data communications between ICAP and Reachback, STEP or legacy networks and systems.

a. High-speed channels shall be operator configurable to support data rates between 1.2 kbps and 1344 kbps.
b. Low speed channels shall be operator configurable to support data rates between 75 bps and 64,000 bps.

3.3.3.2.3 Digitized Voice Channels
The multiplexer function shall include port side T-1/FT1 channels for communication of digitized voice, video, FAX and PC computer modem information.

3.3.3.2.4 IP Router
The multiplexer function shall incorporate an internal IP router to enable statistical multiplexing of IP digital data channels with fixed serial data and digitized voice channels. These channels are typically used for ICAP to ICAP data communication.

3.3.3.2.5 Aggregate Channel Data Rates
As a minimum, the aggregate trunk channels shall be operator configurable to operate at the following transmission rates:

128 kbps	1,024 kbps
256 kbps	1,544 kbps
512 kbps	2,048 kbps

3.3.3.2.6 Bandwidth Management
The multiplexer function shall be configurable by an operator to assign individual channels of the aggregate for specific applications as follows:

a. Specific port channels may be assigned to specific aggregate data channels.
b. Voice compression may be selected on individual digitized voice channels.
c. Echo cancellation may be selected on individual digitized voice port channels.
d. The Promina multiplexer is programmable in the field to assign priority levels to digitized voice and serial data port side channels. In case of congestion (all channels busy), higher priority channels shall preempt lower level channels.

3.3.3.2.7 Transmission Security
Aggregate channels, which interface to external networks and deployed systems via legacy terminals and the LMST, shall be encrypted/decrypted with KG-194 compatible trunk encryption devices.

3.3.4 Network Timing

Network input and output timing (aggregate trunks and SCN digital trunks) shall be based on a primary reference source (PRS) of stratum 1 ($\pm 1 \times 10^{-11}$) accuracy derived from the Global Positioning System (GPS).

a. The PRS shall be backed up with a stratum 2 ($\pm 1 \times 10^{-10}$) or better GPS independent reference source.
b. The backup reference shall immediately take over the timing function when reception of suitable GPS timing data is not possible or ceases for any reason.

3.3.5 Message Switching

The TDC ICAP includes a message switching function that enables users to receive, compose and send AUTODIN/DMS messages.

3.3.5.1 Functional Capability
The message switching function shall provide the following capabilities:

a. Shall have the ability to compose, edit and verify USMTF, JANAP 128, DD-173 and ACP 127 formatted messages.
b. Shall support of AUTODIN Mode I, both block-by-block and continuous, Mode II and Mode VI protocols.
c. Over-the-counter services shall be provided for messages composed using standard word processors, SARAH LITE, JAMPS and DD173.
d. The Message Switch shall have a minimum of three (3) “protocol” ports for the interconnection of AUTODIN external message terminals.
e. The Message Switch shall have two KG 84 compatible encrypted “protocol” ports with both EIA-232 and balanced Conditioned Diphase interfaces.
f. The Message Switch shall have at least two (2) serial X.25 ports for interconnection to external networks.
g. The Message Switch shall have an Internet Protocol 10BaseT Ethernet port for ICAP LAN connectivity to SIPRNET, NIPRNET or other classification in a mutually exclusive fashion.

3.3.6 TRI TAC Telephones

A DSVT Kit Card shall be provided to enable a KY-68 to interface to a legacy TRI-TAC circuit switch at the channel level over the SCN.

3.3.7 Network Management

3.3.7.1 Network Management Terminals
TDC ICAP shall include independent network management terminals for the configuration and status monitoring of the Circuit Switches, Promina Multiplexers and SNMP managed devices from a centralized location.

3.3.7.1.1 Circuit Switch Management

The circuit switch network management function shall have the following features and characteristics:

a. All circuit switches shall include an administration function that enables operator control of the functions shown in Table 18.

Table 18: SCN Administrative Functions

Circuit Switch	1. Assign TDM time slots to subscribers and trunks. 2. Assign subscribers to groups. 3. Control conferencing features. 4. Control internal timers. 5. Control optional features.
Groups	1. Establish dial codes. 2. Set priority. 3. Establish class of service.
Subscribers	1. Establish dial codes. 2. Set priorities. 3. Establish class of service. 4. Set interface characteristics (ISDN BRI digital subscriber channels only).
Trunks	1. Assign members. 2. Define signalling protocols. 3. Establish class of service.

b. All circuit switches shall be capable of administration via local control.
c. All circuit switches shall include a modem to permit administration via a remote terminal.
d. TDC ICAP shall include a circuit switch management terminal capable of both local and remote administration of all TDC ICAP circuit switches.
e. The switch management terminal shall include software that allows it to access TDC ICAP network services such as e-mail, file transfer and web access.

3.3.7.1.2 SNMP Manager
TDC ICAP shall include a network management terminal for administration of all TDC ICAP SNMP compliant devices, with the following features and characteristics:

a. The terminal shall include SNMP compatible network management software, such as Hewlett Packard OpenView.
b. The terminal shall provide a graphic user interface (GUI) for network management functions.
c. The network management terminal shall include software that allows it to access TDC ICAP network services such as e-mail, file transfer and directory look-up.
d. The network management terminal shall contain an uninterruptable power supply that provides a continuous source of prime power for at least 8 minutes after total power failure.

3.3.7.1.3 Panavue Multiplexer Management
TDC ICAP shall include an Multiplexer management terminal for the local administration of all TDC ICAP Promina multiplexers with the following features and characteristics:

a. The terminal shall include NET "Panavue" software, which permits operator configuration and performance monitoring of Promina and IDNX channels and aggregate trunks.
b. The Panavue management terminal shall include software that allows it to access TDC ICAP network services such as e-mail, file transfer and directory look-up.

3.3.7.1.4 Application Server
TDC ICAP shall include an application server with the following features and characteristics:

a. The server shall provide e-mail store and forward capabilities.
b. The server shall provide file transfer services.
c. The server shall support both SMTP (simple mail transfer protocol) and POP (post office protocol) e-mail protocols.
d. The server shall provide UUCP and MIME data encoding.
e. The server shall include software that provides Internet web server capabilities.
f. The server shall include software that permits the creation and management of a TDC ICAP web like *intranet.*
g. The server shall include a minimum of 4 GBytes of hard disk program/data storage.
h. The server shall be implemented with a 32 bit (minimum) processor operating at a clock rate of at least 200 MHz.
i. The server shall incorporate mechanisms to support regular backup of critical data and program storage.
j. The application server shall contain an uninterruptable power supply that provides a continuous source of prime power for at least 8 minutes after total power failure.

3.3.7.1.5 Network Security

TDC ICAP shall provide network security features that prevent unauthorized access to critical data files and network controls as follows:

a. TDC ICAP shall include firewall functions that limit external access to the datagram switched network and internal access to network servers and network managers as follows:

   i. External access shall be limited to specific source IP addresses via defined routing.
   ii. Alerts shall be generated in response to multiple unsuccessful attempts to enter the network.
   iii. External network access attempts shall be logged.
   iv. The firewall shall be programmable to provide TCP proxies for FTP, HTTP, HTTP SSL, NNTP, POP and whois protocols.
   v. The firewall shall be programmable to provide UDP proxies for SNMP and NTP protocols.
   vi. The firewall shall incorporate "type-enforced" SMTP to close sendmail security holes.
   vii. The firewall shall provide a split DNS implementation that hides the internal network from the outside world.
   viii. The firewall shall permit inside-out TELNET communication.
   ix. The firewall shall prohibit outside-in TELNET communication.
   x. The firewall shall be implemented in an independent computer that includes an operator display and input devices.
   xi. The firewall shall provide a graphic user interface (GUI) for configuration functions.

b. All TDC ICAP network management, device management and firewall terminals shall provide controlled access protection equal to or better than Class C2 as defined in DoD 5200.28-STD.

c. All TDC ICAP network management and firewall terminals shall include a software utility that may be used to permanently obliterate all data stored on the terminal's internal hard disk.

3.4 LOGISTICS REQUIREMENTS

All Modules shall accommodate a two level maintenance concept; organizational (Air Force personnel) and depot (contractor personnel). Removal and replacement of an LRU is defined as organizational level maintenance and any needed repair of the LRU is defined as depot level maintenance. An LRU is defined as the lowest element of the module which can be isolated to be faulty through inspection; built-in test; technical manuals; TDC-ICAP system performance; spares substitution; or other diagnostic aid approved by the Government for organizational level maintenance, exclusive of expendables such as fuses, lamps and LEDs.

a. Any special test or support equipment required to remove or replace an LRU at the organizational level shall be provided as part of the module.
b. No more than two persons shall be required to remove or replace an LRU.

3.4.1 Reliability

TDC-ICAP Modules are a complement of LRUs, having a mean time between failure (MTBF) commensurate with similar commercial equipment in its class. The actual MTBF for the major system components can be found in the individual Module Requirement Document (MRD).

3.4.2 Maintainability

The ICAP equipment is designed to operate 24 hours per day, seven (7) days a week.

3.4.2.1 Mean Time to Repair
The mean time to repair at the organization level of any Module shall be 30 minutes or less. Ninety-five percent (95%) of the repairs shall be completed in less than 60 minutes.

3.4.2.2 Fraction of Failures Detected
Failure detection shall be accomplished to the maximum extent possible at the organizational level by built-in test (BIT).

3.4.2.3 Fraction of Failures Isolated
The fraction of failures isolated at the organizational level shall be 100% to less than five (5) LRUs by a combination of BIT, manual test procedures, external test equipment and technical manuals. 100% of the failures shall be isolated to one LRU using BIT plus sequential replacement and test (i.e., substitution) of LRUs.

3.4.2.4 Preventative Maintenance
The duration of preventative maintenance actions such as corrosion control, cleaning filters, etc., shall not exceed 30 minutes and shall not interrupt customer service.

3.5 ENVIRONMENTAL REQUIREMENTS

3.5.1 Temperature

During storage and transport, each Module and Component (in its carrying case) shall withstand exposure to temperatures from -40°C (-40°F) to +60°C (+140°F). During operation, all Modules and Components shall withstand exposure to temperatures from 0°C (+32°F) to +40°C (+104°F). Any part of a module which is required to operate outdoors; e.g., exposed subassemblies of the Microwave and Laser Modules; shall operate over the temperature range of -20°C (-4°F) to +50°C (+122°F).

3.5.2 Relative Humidity

All Modules and Components shall withstand exposure to a relative humidity of 10% to 90%, non-condensing.

3.5.3 Altitude

During storage and transport, Modules and Components shall withstand exposure to altitudes from 100 ft. below mean sea level (BMSL) to 50,000 ft. above mean sea level (AMSL). During operation, Modules and Components shall withstand exposure to altitudes from 100 feet BMSL to 10,000 feet AMSL.

3.5.4 Sand and Dust

During storage and transport, Modules and Components shall be protected when exposed to sand and dust in accordance with the best commercial practices for close proximity to operating aircraft. During operation with covers removed, the Modules and Components shall be designed in accordance with the best commercial practices to function in a dust environment produced by man's natural activities.

3.5.5 Shock and Vibration

3.5.5.1 Shock

ICAP shall be protected from shocks induced during handling, setup and teardown. Modules and components shall operate without degradation following exposure to the non-operating shock environment of described by Method 516.4, Procedure VI (Bench Handling) of MIL STD 810E.

3.5.5.2 Vibration

Modules and components shall be designed to withstand the vibration encountered while being transported by commercial and military airlift, sealift and vehicular (over unimproved roads) systems.

3.6 OTHER REQUIREMENTS

3.6.1 Safety

The equipment design criteria for the equipment shall be in accordance with Best Commercial Practice, including NFPA-70, National Electric Code and Title 29, Code Of Federal Regulations, Chapter XVII, Part 1910, "Occupational Safety Health Standards" and the requirements identified below.

3.6.1.1 Electrical Safety
All modules shall be designed to eliminate the hazard to personnel of inadvertent lethal voltage contact.

a. Components operating over 500 volts shall be completely enclosed and interlocked to automatically disconnect power behind the barrier upon removal with no bypass devices permitted and shall be marked.
b. All electrical conductors carrying voltages in excess of 70 volts must be insulated to prevent contact or covered by a protective barrier.
c. All removable protective barriers must be interlocked or clearly marked with a warning label that indicates the voltage potential that will be encountered behind the barrier. If warning labels are used, the warning shall remain visible after the cover has been removed.

3.6.2.2 Mechanical Safety
Sharp surfaces shall have protective covers or other suitable features to minimize injury where personnel are likely to be exposed to such surfaces.

3.6.2.3 Grounding
a. The equipment design shall ensure all non current-carrying metal parts are grounded by non current-carrying conductors.
b. The ground wire shall be terminated at both ends and shall be of the same or larger size and current rating as the largest companion cable conductors or the sum of all paralleled conductors.
c. The ground wire shall carry no current at any time other than during a ground fault.

3.6.2 Power

TDC ICAP shall operate from commercial utility, commercial generators, and existing inventory tactical generators.

a. TDC shall operate using nominal 120/240 VAC ±10%, 50/60 Hz single-phase power.
b. All equipment shall be provided with lightning protection and power conditioning designed to protect against damage due to line transients.

3.6.3 Chemical, Biological and Radiological Characteristics

The ICAP modules shall be operable by personnel dressed in chemical, biological and radiological ensemble.

4.0 QUALITY ASSURANCE REQUIREMENTS

Prior to initiation of system level tests all modules must be accepted in accordance with individual MRDs.

4.1. RESPONSIBILITY FOR INSPECTION

Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspections and may use his own or any other suitable facilities. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to the prescribed requirements.

4.2 QUALITY CONFORMANCE INSPECTIONS

The contractor shall perform inspections at system (first-article delivery) and module levels in accordance with Table 11 to verify that the delivered equipment meets or exceeds the requirements contained in Section 3 herein. Table 19 provides a verification cross reference matrix (VCRM) which lists each paragraph in Section 3 and the method used to verify any requirements contained therein. Where more than one verification method is shown, one method or a combination of methods may be used to show compliance. Specific testing methods and procedures will be documented in separate test plans and procedures.

4.2.1 Qualification Methods

Qualification methods for each inspection listed in Table 19 may be one or more of the following types:

a. Not Required (N/R). This method indicates that verification is not required because the paragraph is a title, heading, general introductory paragraph or statement of a goal and contains no “shall” or “must” statements.

b. Inspection. Inspection is a method of verification of the system performance or characteristics by examination of the equipment or associated documentation. Inspections are conducted with the use of inspection tools, measurement devices, visual means and comparison. Most inspections apply to verification of requirements associated with physical characteristics such as size, weight, appearance, adherence to specified standards and engineering practices, quality design, and construction supported with quality documentation. Inspections also include the auditing of manufacturer’s data that verifies the performance of non-developmental items that comprise the TDC ICAP system. Inspections may occur during any phase of the program.

c. Analysis. Analysis is a method of verification through technical evaluation of calculations, computations, models, analytical solutions, use of studies, reduced data, and/or representative data to determine that the item conforms to the specified requirements.

d. Demonstration. Demonstration is a method of verification whereby the properties, characteristics and parameters of the item are determined by observation alone and without the use of instrumentation for quantitative measurements. This method is used when a requirement does not contain a specific numerical parameter which must be measured. Demonstrations may occur during any phase of the program. Pass/fail criteria are simple yes/no indications of functional performance since no quantitative values are specified.

e. Test. Test is a method to verify that a specified requirement is met by thoroughly exercising the applicable item under specified conditions and by using the appropriate instrumentation in accordance with test procedures. This method requires the use of laboratory equipment, simulators, or services to verify compliance to the specified requirements. This method is used when it is practicable to make direct or indirect measurement of a specified numerical parameter to verify compliance with a requirement. Tests may occur during any phase of the program. Actual measured values are recorded, and pass/fail is determined by comparing the measured value with the specified value. Measurement accuracy is precise enough to ensure that the measured value is within the specified tolerance.

4.2.2 System Level Demonstrations

Demonstrations required by Table 19 are performed by configuring a set of modules into a notional configuration and then operating those modules to simulate an actual user function or mission. These simulated operations, referred to as scenarios, shall be performed incrementally to show a build-up from a small initial deployment to a large sustained operation. For example, initial scenarios may be used to demonstrate individual nodes followed by a few nodes interconnected via the backbone to a single network hub. The final scenario shall be notional configuration designed to support the Joint Air Force Component Command (JFACC).

Table 19: Verification Cross-Reference Matrix

Paragraph	Title	Verification Method				
		PQT				
		N/R	In-spect	An-alysis	Demo	Test
3.0	Requirements	X				
3.1	Network Architecture	X				
3.1.1	Network Types	X				
3.1.1.1	Switched Circuit Network	X				
3.1.1.1.1	Circuit Switches	X				
3.1.1.1.2	ISDN Compatibility	X				
3.1.1.2	Datagram Switching Network	X				
3.1.1.2	Datagram Switching Networks	X				
3.1.1.3	Local Area Networks	X				
3.1.1.4	Backbone Connections	X				
3.1.1.5	Metropolitan Area Network	X				
3.1.1.6	Wide Area Network	X				
3.1.2	Modularity and Scalability	X				
3.1.2.1	Network Backbone	X				
3.1.2.1.1	Cable Sets	X				
3.1.2.1.2	Microwave Module	X				
3.1.2.1.3	Laser Module	X				
3.1.2.1.4	TSSR Interface Unit Module	X				
3.1.2.2	Subscriber Services	X				
3.1.2.2.1	Basic Access Module	X				
3.1.2.2.2	Configuration Access Module (Obsolete)					
3.1.2.2.3	Red Hub	X				
3.1.2.2.4	Red Router Module	X				
3.1.2.2.5	Secure Voice Module	X				
3.1.2.2.6	Remote Distribution Frames	X				
3.1.2.2.7	ISDN Terminal Adapters	X				
3.1.2.2.8	Telephone Sets	X				
3.1.2.2.9	DSVT Kit	X				
3.1.2.3	Network Services	X				
3.1.2.3.1	Legacy PTT/Voice Module	X				
3.1.2.3.2	Promina Multiplexer Modules	X				
3.1.2.3.3	Uninterruptable Power Supplies	X				
3.1.2.3.4	Crypto Module	X				
3.1.2.3.5	AN/FCC-100 Multiplexer	X				
3.1.2.3.6	Message Terminal Module	X				
3.1.2.3.7	Crypto Interface Module	X				
3.1.2.3.8	Network Management Modules	X				
3.1.2.3.9	Laptop Personal Computer Terminals	X				
3.1.2.4	Extended Module Capability	X				

Table 19 Cont'd: Verification Cross-Reference Matrix

Paragraph	Title	Verification Method				
		PQT				
		N/R	Inspect	An-alysis	Demo	Test
3.2	Integration and Interfaces	X				
3.2.1	Legacy System Interoperability	X				
3.2.1.1	TRI-TAC Loop Interfaces	X				
3.2.1.2	TRI-TAC Group Interfaces	X				
3.2.1.3	Interface to Reachback or STEP	X				
3.2.1.4	Interface to ARFOR and Joint Forces	X				
3.2.1.5	Interface to TASDAC	X				
3.2.1.6	Interface with TDC ICAP	X				
3.2.1.7	System Timing	X				
3.2.2	Module-to-Module Interfaces				X	
3.2.3	Network Interfaces				X	
3.3	Functional Requirements	X				
3.3.1	Switched Circuit Network	X				
3.3.1.1	Network Subscribers				X	
3.3.1.2	Circuit Switches				a - f	
3.3.1.3	Network Bandwidth		X			
3.3.1.4	DSN Operation				X	
3.3.1.5	Secure Conferencing				X	
3.3.1.6	External DoD Interface		X			
3.3.1.7	External TELCO Network Interface		b		a	
3.3.1.8	Secure PTT Radio				a - c	
3.3.2	Datagram Switching Network	X				
3.3.2.1	Internet Protocol			X		
3.3.2.2	Network Services				X	
3.3.2.2.1	Uninterruptable Power Supplies				X	
3.3.2.3	Network Segmentation				X	
3.3.2.4	Network Backbone				X	
3.3.2.5	External Network Connectivity				X	
3.3.3	ICAP Network Connection	X				
3.3.3.1	Metropolitan Area Network	X				
3.3.3.1.1	Wired Connections			d	a - c	
3.3.3.1.2	Wireless Connections		b	a	c	
3.3.3.2	Multiplexed Wide Area Network				X	
3.3.3.2.1	Compatibility				X	
3.3.3.2.2	Serial Data Channels				a, b	
3.3.3.2.3	Digitized Voice Channels				X	
3.3.3.2.4	IP Router				X	
3.3.3.2.5	Aggregate Channel Data Rates				X	
3.3.3.2.6	Bandwidth Management				X	
3.3.3.2.7	Transmission Security				X	
3.3.4	Network Timing			a	b	
3.3.5	Message Switching	X				
3.3.5.1	Functional Capability		d, e, f, g		a, b, c	
3.3.6	TRI TAC Telephones				X	

Table 19 Cont'd: Verification Cross-Reference Matrix

Paragraph	Title	Verification Method				
		PQT				
		N/R	In-spect	An-alysis	Demo	Test
3.3.7	Network Management	X				
3.3.7.1	Network Management Terminals				X	
3.3.7.1.1	Circuit Switch Management				a - e	
3.3.7.1.2	SNMP Manager		a		b, c	d
3.3.7.1.3	Panavue Multiplexer Management				a, b	
3.3.7.1.4	Application Server		g - i		a - f	j
3.3.7.1.5	Network Security		a.vi, avii, aix, ax, c	b	a.i - a.v, aviii, a.xi	
3.4	Logistics Requirements			a, b		
3.4.1	Reliability			X		
3.4.2	Maintainability	X				
3.4.2.1	Mean Time to Repair			X		
3.4.2.2	Fraction of Failures Detected			X		
3.4.2.3	Fraction of Failures Isolated			X		
3.4.2.4	Preventative Maintenance			X		
3.5	Environmental Requirements	X				
3.5.1	Temperature					X
3.5.2	Relative Humidity					X
3.5.3	Altitude					X
3.5.4	Sand and Dust					X
3.5.5	Shock and Vibration	X				
3.5.5.1	Shock					X
3.5.5.2	Vibration					X
3.6	Other Requirements	X				
3.6.1	Safety		X			
3.6.1.1	Electrical Safety					a - c
3.6.1.2	Mechanical Safety					X
3.6.1.3	Grounding		a, b			c
3.6.2	Power					a, b
3.6.3	Chemical, Biological and Radiological				X	X

5.0 PREPARATION FOR DELIVERY

TDC ICAP consists of a set of building blocks, which are designed to implement virtually any base communication infrastructure. Consequently, orders for TDC ICAP will occur at the module and component level. Each module or component shall be packaged for shipment and the package marked in accordance with the requirements of the contract under which the module is ordered.

6.0 ACRONYMS

Abbreviations and acronyms that are used throughout this document are tabulated as follows:

Table 20. ACRONYMS

AAU	Analog Appliqué Unit
ACP	Allied Communication Publication
AF	Air Force
ALTU	Analog Line Termination Unit
AMSL	Above Mean Sea Level
ARFOR	Army Forces
ASC	AUTODIN Switching Center
AT&T	American Telephone and Telegraph Company [Lucent Technologies]
AUI	Attachment Unit Interface
AUTODIN	Automatic Digital Network
AUTOVON	Automatic Voice Network
AWG	American Wire Gauge
BAM	Basic Access Module
BIT	Built-In Test
BMSL	Below Mean Sea Level
BRI	[ISDN] Basic Rate Interface
CAM	Configurable Access Module
CDI	Conditioned di-phase
CDRL	Contract Data Requirements List
CELP	Code-Excited Linear Prediction
CEPT	Conference European Post Telegraph
CIM	Crypto Interface Module
CKT	Circuit
CL	Clock
CO	Central Office
CONUS	Continental United States
CSMT	Circuit Switch Management Terminal
CT	Cipher Text
CVSD	Continuously Variable Slope Delta
dB	Decibels
DCE	Data Communication Equipment
DMS	Defense Message System
DNS	Domain Name Server

ACRONYMS

DoD	Department of Defense
DSN	Defense Switched Network
DSVT	Digital Subscriber Voice Telephone [KY-68]
DTE	Data Terminal Equipment
DTG	Digital Trunk Group
DTG	Digital Transmission Group
DTMF	Dual Tone Multi-Frequency
E&M	Ear and Mouth
EIA	Electronic Industries Association
EMUT	Enhanced Multi-User Terminal
ESF	Extended Super Frame
ESS	Electronic Switching System
F/O	Fiber Optic
FAX	Facsimile
FDDI	Fiber Distributed Data Interface
FTP	File Transfer Protocol
FXO	Foreign Exchange Office
FXS	Foreign Exchange Subscriber
GMF	Ground Mobile Forces
GPS	Global Positioning System
GSRD	Ground Start Ringdown
GUI	Graphical User Interface
HQ	Headquarters
HS	High Speed
HTTP	Hyper Text Transfer Protocol
I/O	Input/Output
IAW	In accordance with
ICAP	Integrated Communication Access Package
IDNX	Integrated Network Digital Exchange
IDNX MT	IDNX Management Terminal
IEEE	Institute of Electric and Electronic Engineers
IP	Internet Protocol
ISDN	Integrated Subscriber Digital Network
ITU	International Telecommunications Union
JAMPS	JINTACCS Automated Message Processing System
JANAP	Joint Army-Navy-Air Force Protocol
JFACC	Joint Forces Air Component Commander
LAN	Local Area Network
LED	Light Emitting Diode

ACRONYMS

LGCY	Legacy
LGM	Loop Group Multiplexer
LMST	Light Weight Multiband Satellite Terminal
LOS	Line of Sight
LRM	Low Rate Multiplexer
LRU	Line Replaceable Unit
LS	Low Speed
LSRD	Loop Start Ringdown
LTU	Line Termination Unit
LVM	Large Voice Module
MAN	Metropolitan Area Network
MIME	Multipurpose Internet Mail Extension
MLPP	Multi-Level Preemption and Priority
MRD	Module Requirements Document
MSE	Mobile Subscriber System
MSG	Message
MTBCF	Mean Time Between Critical Failure
MUX	Multiplexer
NA	Not Applicable
N/R	Not Required
NES	Network Encryption System
NET	Network
NIPRNET	uNclassified Internet Protocol Router Network
NMT	Network Management Terminal
NMT-P	Network Management Terminal - Pentium
NMT-U	Network Management Terminal - Ultra [SPARC]
NNTP	Network News Transfer Protocol
NRZ	Non-Return to Zero
NSA	National Security Agency
NTP	Network Time Protocol
P-P	Point-to-Point
PBX	Private Branch Exchange
POP	Post Office Protocol
POTS	Plain Old Telephones
PRI	[ISDN] Primary Rate Interface
PRS	Primary Reference Source
PT	Plain Text
PTT	Push to Talk
RCI	Remote Control Interface

ACRONYMS

RDDF	Remote Data Distribution Frame
RF	Radio Frequency
RLGM	Remote Loop Group Multiplexer
RMC	Remote Multiplexer Combiner
RSC	Red Station Clock
RVDF	Remote Voice Distribution Frame
RX	Receive
SARAH	Standard Automated Remote to AUTODIN Host
SATCOM	Satellite Communication
SCN	Switched Circuit Network
SF	Single Frequency [signalling]
SF	Super Frame [T-1]
SINCGARS	Single Channel Ground & Airborne Radio
SIPRNET	Secret Internet Protocol Router Network
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SRD	System Requirements Document
SSAD	System Specification and Architecture Document
STEP	Standard Tactical Entry Point
STU-III	Secure Terminal Unit - III
SW	Switch
T/R	Transmit/Receive
TA	[ISDN] Terminal Adapter
TASDAC	Tactical Secure Data Communications
TDC	Theater Deployable Communication
TDM	Time Domain Multiplexing
TED	Transmission Encryption Device
TELCO	Telephone Company
TGM	Trunk Group Multiplexer
TIU	TSSR Interface Unit
TRI-TAC	Tri-Service Tactical Communications
TSSP	Tactical Satellite Signal Processor
TSSR	Tropo-Satellite Support Radio
TX	Transmit
UDP	User Datagram Protocol
UHF	Ultra High Frequency
UPS	Uninterruptable Power Supply

ACRONYMS

USMTF	Uniformed Services Message Text Format
UUCP	Uunet Communications Protocol
VDR	Voice Digitization Rate
WAN	Wide Area Network
WECO	Western Electric Company

† All of the circuit switches contained in ICAP modules have one additional analog subscriber port that is wired to a modem used for remote circuit switch administration.

† The LRM can accept channel rates up to 56 kbps. See Table V-2 of CJSM 6231.04 for a list of compatible data rates.